

The AMSAT[®] Journal

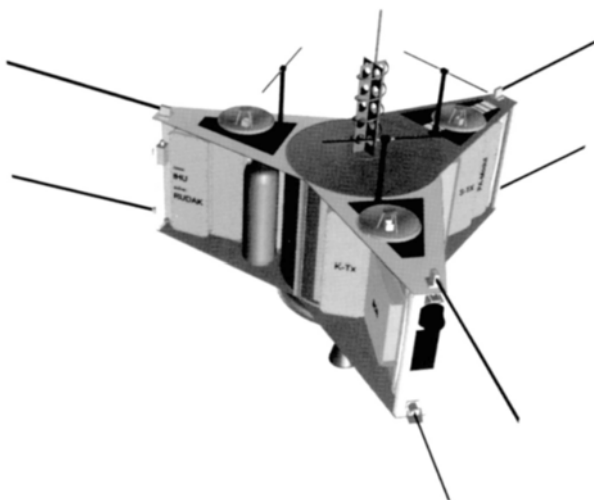
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Volume 27, Number 2

March/April 2004

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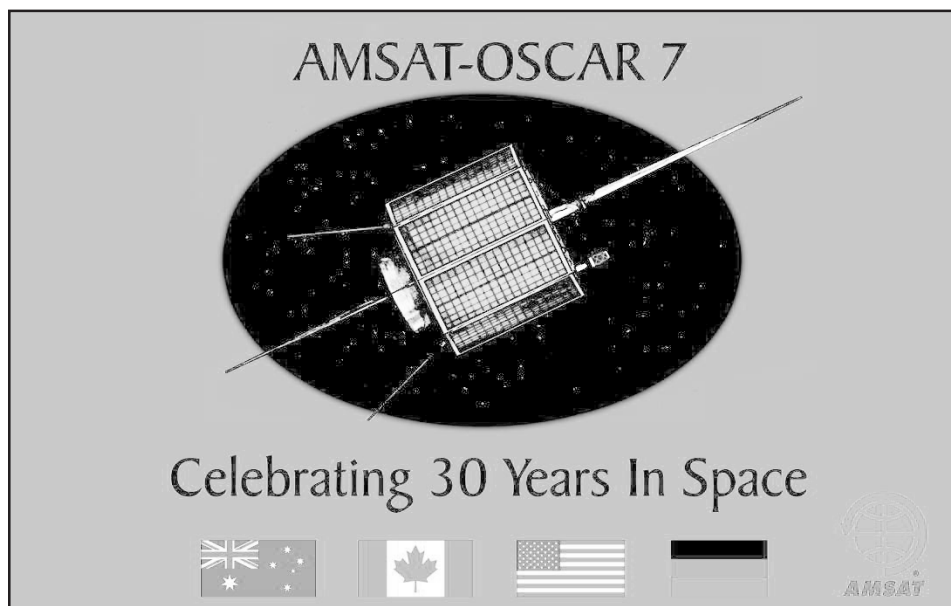
Support AMSAT-NA

Happy Birthday AO-7

by Bruce Paige, KK5DO • kk5do@amsat.org

To commemorate the 30th anniversary of AO-7, AMSAT-NA has created a special QSL card, as shown at <http://www.amsat.org/amsat/catalog>. The cards are offered for a donation to AMSAT-NA headquarters in bundles of 25 cards (\$15), 50 cards (\$25), or 100 cards (\$40), including shipping to anywhere. To get your AO-7 Commemorative QSL cards, contact Martha at +1 (301) 589-6062 to order, or donate by PayPal transfer to martha@amsat.org and indicate that it is for AO-7 Commemorative QSL cards.

73...Bruce





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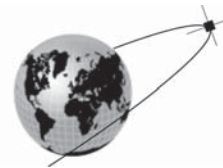
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APOGEE VIEW

by Robin Haighton, VE3FRH • ve3frh@amsat.org



It is always a pleasure to report good progress whether that progress is the building of a satellite or the development of AMSAT's long-term goals and objectives.

On this occasion it is a combination of both of these in that your senior officers together with members of the Board of Directors have been in the process of renewing AMSAT's Strategic Plan. You may have seen my brief report in February, which was sent to all members shortly after our planning meeting. Now we are moving along with the development of the New AMSAT. The formation of AMSAT 35 years ago was a landmark in Amateur Radio, it was carried out by a highly motivated group of technically orientated individuals who saw opportunities and had the vision to develop Amateur Radio satellites. These individuals attracted other similarly inclined people to their group and AMSAT was formed. A worthy successor to the "Project Oscar" organization on the west coast of the USA.

Now, some 35 years later, we who have inherited AMSAT from the founders, are aware that our membership requires us to move in a planned and organized way to meet a new set of goals and objectives, and that those objectives must meet the needs of the satellite operators, educators, our own designers and industry if we are to be able to raise the funds necessary to design, build, launch and operate satellites in the twenty-first century.

The proposed new satellites from AMSAT will be high earth orbit satellites as we foresee other organizations developing (and launching) LEO birds. Through education we anticipate that we may assist in the design of LEOs but after Echo we will not become the prime agency in the development of LEO satellites in the foreseeable future.

Currently there are several LEO satellites awaiting launch, namely VUSat from India, BlueSat from Australia (University of NSW) and KiwiSat from New Zealand. We anticipate that more LEO satellites will be developed in the next few years.

Our proposed High Earth Orbit satellites will be designed and launched to provide a ring of satellite operation in conjunction with the P3E satellite that AMSAT-DL is currently developing and which will probably be launched in 2006.

P3E will provide coverage about every other day to most of the world. Eagle, which will follow P3E about three years later, will provide coverage every day and the following satellite should mean that we have

continuous coverage. Orbits for these last two satellites have yet to be planned.

The payload of each satellite will be adjusted dependent on those of the previous launches together with the ongoing desires of the membership and the advances in technology that take place over the next 5 or 6 years. Satellites are growing both smaller and more complex. We are able to achieve technology inside an Eagle satellite (60 cm/2 ft cube) which would have taken a P3D size satellite to accomplish only a few years ago.

However, launches are more expensive, particularly for high earth orbit (or GTO) and may cost several times the build cost of the satellite. We have to find ways to meet these costs.

In support of these new initiatives revised funding methods are being investigated and AMSAT has already put in place an Endowment Fund Committee to handle bequests, grants and major donations. The Duties, Policies, Rules and Regulations of the Endowment Fund Committee of AMSAT may be viewed on our Web site (www.amsat.org). We will still have to rely on our membership for a substantial amount of our funding and to be successful we must start increasing our membership. You can help us in several ways. First be prepared to talk about your membership in AMSAT with friends and work colleagues. Wear a "Presidents Club Button" at all ham radio functions and wherever else you can do so.

Support AMSAT activities with whatever funding you can afford (have you contributed to the Echo Launch Fund yet?). Every cent counts. There will be many opportunities to participate in the future. Can you do so? Could you join a technical review group to review the design of a part of a satellite? Maybe you would feel more comfortable as a fundraiser or in some administrative/communications role. AMSAT needs your help. The new satellites will keep us all very busy. Please fill out a volunteer sheet (see the Web site) and let us know what you can do to help the New AMSAT.

73,

Robin Haighton,

VE3FRH

President AMSAT 



What is AMSAT®?

AMSAT members are a worldwide group of enthusiastic individuals designing, building and operating Amateur Radio satellites as part of our program of space science education.

The Radio Amateur Satellite Corporation (AMSAT or AMSAT-NA) is a non-profit scientific and educational organization chartered in Washington, DC, in 1969. Since then, AMSAT and colleague organizations around the world have built over 50 ham radio satellites. Fifteen of these satellites continue in operation.

Joining AMSAT supports our current projects: Eagle, AMSAT-OSCAR-E (Echo) and ARISS. Eagle is a high orbit DX capable satellite planned for a 2007 launch. Echo is a low orbit FM and digital bird you will be able to use with simple equipment, planned for launch in 2004. And ARISS is our program on the International Space Station. You will keep up to date on the world of Amateur Radio satellites with 6 issues of the AMSAT Journal every year.



We'd like to have you as a member!

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Do you send QSL cards for satellite contacts? You can help AMSAT by inserting a form describing AMSAT and providing membership information when you send your QSL's. Put one of these inserts in with every QSL mailing and you will help other hams find out about AMSAT and you will help AMSAT to build new satellites by helping to add new members.

Included at the [amsat.org](http://www.amsat.org) Web site are forms for single sided printing ... just print, cut, fold and mail. You can also find forms for double sided printing if you prefer.

You can find the AMSAT QSL inserts on-line at:

<http://www.amsat.org/amsat/amsat-na/membership.html>

(right) Rick Hambly, W2GPS, AMSAT Executive VP, shown viewing the AMSAT QSL insert.



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P3-Express – An Intermediate Report

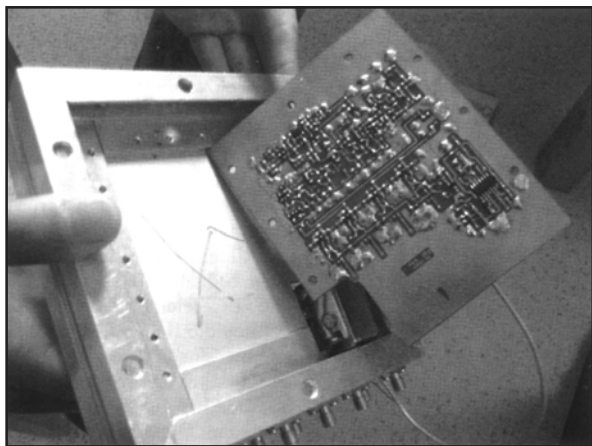
by Peter Gülzow, DB2OS

This article first appeared in the December/February 2003/2004 issue of AMSAT-DL Journal

Translated from German by: John J. Bubbers, W1GYD

The work on P3E has taken several steps forward; the form and function of the new satellite has been crystallized after many examinations and discussions.

An important subject for the last three months has been the establishment of the propulsion system with our friends and partners at Astrium. Since the well-known 400-N propulsion system is no longer available, essential elements of the previous propulsion system had to be modified. A 220-N propulsion system will be installed that will have to be ignited more frequently and for longer periods. After a few corrections the tank has passed its tests as a first element.



The work on two key energy components, the batteries and the solar arrays, has also progressed. About 100 different NiMH cells were conditioned and measured. A flight package of ten will be selected from the measured units on hand. For the solar arrays we are being advised of the proper approach externally. Several proposals were received, that are now in hand. The individual panels consist of three layers, a carrier substrate that AMSAT-DL will provide, the solar cells and a glass cover which is about 0.5 mm thick. From our experience the solar generator will be the most expensive single item on the satellite.

The transponder configuration in the microwave region was uncertain for a long time. The solution was found after a meeting with Michael Kuhne and Freddy Guchteneire, as well as a way to integrate a

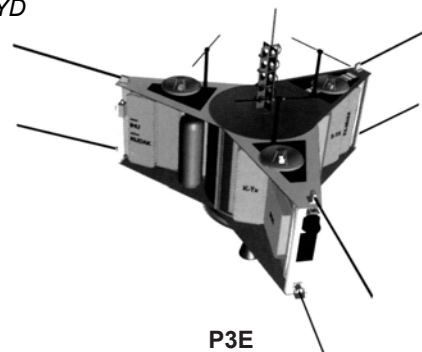
transmitter for 24 GHz and also one for 47 GHz. Both will have a passband of about 50 kHz and a beacon outside of the passband. The 24 GHz transmitter will be in its own module and provide an output power of several Watts. The 47 GHz transmitter will share a module with the 5.6 GHz receiver and will deliver an output power of 1 W.

The antenna configuration has been modified by these changes. For the lower bands of 145 and 435 MHz the established systems (dipole, radiator/director combination) will be used again. Freddy Guchteneire would like to try a combination solution for the S-Band and L-Band using a central helix. Additionally, each satellite arm carries a 15-cm parabolic reflector.

Each arm has one for the X-Band high power downlink, one for 24 GHz, one for 47 GHz and 5.6 GHz. In addition, there will be an omni-antenna for 145 and 435 MHz as well as various low gain antennas for the P5 transponder. Details of the U/V transponder were cleared up in a further meeting with William Leijenaar. The flight hardware is already being built, since William would like to travel the world after he completes his studies and work on P3E.

A receiver for 29 MHz is completely new in the discussions. A short-wave receiver could be more attractive with the opening of the HF bands for previously limited license holders since after the lifting of the Morse code license requirement they can now use the HF frequencies; this has already begun in several countries. A higher uplink transmitter link budget can be easily achieved on these frequencies, which provides a good link budget at the perigee. The problem, however, is the satellite's receiving antenna for which there is currently no solution.

The necessary coordination process of the satellite frequencies has begun with the progress of the design and construction of the

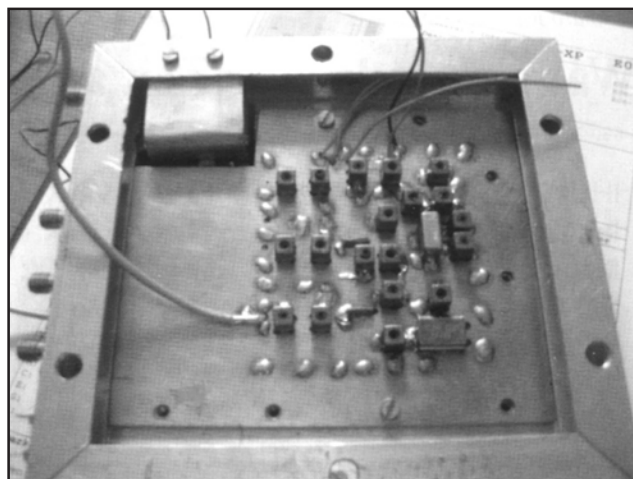


P3E

transponder modules. The table shows the frequencies that were proposed to the IARU frequency panel. We currently assume that there will be only minor changes. It is worth mentioning the frequencies above 5.6 GHz. For some time there has been an agreement between terrestrial narrow band and satellite segments that partially overlap.

This opens up the possibility to provide frequencies in which a transverter can work in both regions – satellite and terrestrial. The user group could thereby be enlarged in this frequency region.

The circuit design for the IHU3 has been completed. The new IHU3, which has been already assigned to the Mars mission, follows a new command concept. Previously signal recognition and decoding was performed by analog and digital hardware. The more powerful CPU will perform these functions. The on-board IHU3 computer will receive an LF signal from the command receiver. This modified concept was a result of the requirements for the P5A-Mission. In "emergency" operation, if, for example, the high gain antennas are not pointing to the earth, have low gain and a large squint angle, they will have to work at a 5 character/second rate. A long integration time has to be



invoked at these low rates. In the previously established technique just the signal recognition, the scanning of the command passband, would take up to 3,000 seconds or 50 minutes.

This new technology, which is invoked in the IHU3, can examine the passband in parallel by using a DSP. This shifting of the on-board computer means, however, that there can never be a computer crash, since the signal recognition for the command operation would drop out, and a classical RESET would no longer be possible. A smart, multi level watchdog system was developed as a result. For this the CPU has to compute the bit sequences on different processing levels, whose accuracy releases the triggering of the watchdog. If the watchdog fails to function correctly and doesn't result in correct bit sequences or in no bit sequences, then the watchdog logic can undertake various measures, among them is to switch over to different stored copies of the operations software.

Finally, it can be reported that the P3E metal structure has already been lacquered at press time. The black, space qualified lacquer serves to balance the thermal conditions.



SATELLITE FUN FROM P.R.



Angel Santana, WP3GW, works UO-14 on July 4, 2003 from his front yard in Trujillo Alto, Puerto Rico, FK78aj. Contacts included one with Bruce, KK5DO.

P3E Frequency Proposals

29 MHz Uplink (A)	
RUDAK:	29.500 +/- 5 kHz (multi-mode, low-speed)
PB:	29.325 +/- 25 kHz (linear)
145 MHz Downlink (V)	
GB:	145.812 (PSK 400 b/s)
EB:	145.957 (PSK 400 b/s)
RUDAK:	145.837 (multi-mode, low-speed)
PB:	145.845 to 145.945 (linear)
435 MHz Uplink (U)	
RUDAK:	436.200 to 436.350 (multi-mode)
PB:	436.050 to 436.150 (linear)
1260 MHz Uplink1 (L1)	
RUDAK:	1268.775 to 1268.925 (multi-mode)
PB:	1268.600 to 1268.750 (linear)
1260 MHz Uplink2 (L2 - GALILEO - Alternative)	
RUDAK:	1260.275 to 1260.425 (multi-mode)
PB:	1260.100 to 1260.250 (linear)
2400 MHz Downlink (S)	
GB:	2400.250 (PSK 400 b/s)
EB:	2400.500 (PSK 400 b/s, high-speed option)
RUDAK:	2400.600 to 2401.000 (multi-mode, low/high-speed)
PB:	2400.275 to 2400.425 (linear)
5650 MHz Uplink (C)	
PB:	5668.600 MHz +/- 25 kHz (linear)
24 GHz Downlink (K)	
PB:	24048.300 MHz +/- 25 kHz (linear)
Beacon:	24048.350 MHz
47 GHz Downlink (R)	
PB:	47088.300 MHz +/- 25 kHz (linear)
Beacon:	47088.350 MHz
2450 MHz Uplink (S) - 10450 MHz Downlink (X)	
This is related to the P5A experimental transponder. It requires a stable frequency relationship in coherent mode and about 2 MHz in ranging mode. It is also a linear transponder with a useable bandwidth of about 50 kHz. The final frequency coupling has not yet been finalized.	
Legend	
GB	= General Beacon
EB	= Engineering Beacon
PB	= Passband
RUDAK	= Digital Multi-Mode Payload



AMSAT OSCAR-E Project

Spring 2004 Status Report

by Richard M. Hambly, W2GPS

This status report about AMSAT-OSCAR-E ("Echo") is a companion article to the presentation given at the Maryland-DC area Annual AMSAT Meeting in March 2004 and to the previous articles published in the AMSAT Journal^{1,2,3}, the AMSAT Proceedings⁴ and CQ/VHF^{5,6,7}.

Latest News:

On December 8, 2003 a team led by Jim White, WD0E, and Mike Kingery, KE4AZN, arrived at SpaceQuest in Fairfax VA to begin the process of integrating Echo's various hardware and software subsystems. After two weeks of long hours and hard work the team had the core systems working and had successfully tested much of the experimental hardware.

During January and February the Echo integration team continued working with the designers of the flight and ground software and with the developers of the S-Band transmitter and the Digital Voice recorder to finalize Echo and get it ready for flight.

In mid-February we received the news that the primary payload for our launch was experiencing delays and so the launch window has been pushed back to a two-month period beginning June 28, 2004. While disappointing, this will give us time to further refine the software and to get the experimental payloads installed and fully tested.

Operations and Capabilities

As has been reported in previous articles, Echo will offer a wide range of capabilities that will support operations interests from "EasySat" operations to scientific experiments.

In anticipation of Echo's launch an operations committee has been formed to determine the initial operating schedule for Echo after commissioning is complete. The initial proposed schedule is as follows, but keep in mind that this is preliminary and subject to change at any time.

FM voice repeater mode will be active all the time on one channel (except see experimenters' day below), 145.920 MHz uplink with 67 Hz PL tone and 435.225 MHz downlink, one watt minimum. This mode will use CTCSS keyed mode, which means that the transmitter comes on only when it hears a 67 Hz PL for one second or more and stays on for up to ten seconds after the tone disappears. The transmitter power is controlled automatically by software and may be as high as six watts output when sufficient DC power is available.

Digital mode will also be active all the time on one channel (except see experimenters' day below), 145.860 MHz uplink at 9,600 baud, 435.150 MHz downlink also at 9,600 baud. The transmitter will be set to one watt all the time. The software on the satellite will be set to run a store and forward bulletin

board system (BBS) using the callsigns PACB-11 for broadcast and PACB-12 for the BBS. Echo's digital mode is just like that of UO-22, a store-and-forward BBS using the P A C S A T Protocol Suite. The digital downlink will also contain periodic real-time telemetry and Echo's whole orbit data

will be available in its file system for download. It is also possible that Echo will broadcast periodic APRS status messages.

Experimenters' day is every Wednesday (UTC). Any other mode that Echo is capable of implementing may be in use from Wednesday from about 0000 UTC to about 2359 UTC. Modes will be scheduled a week or more in advance. If no experiment is scheduled Echo will be in the default experimental mode which is digital operation using 1268.700 MHz uplink at 9,600 baud and 2401.200 MHz downlink at 38,400 baud. We expect the most common other experimental modes to be Mode L/S FM voice and Mode L/S with 9,600 baud uplink and 38,400 or 76,600 baud downlink.

There are many other possible modes that can be implemented by using Echo's various capabilities in creative combinations. As has been published before, Echo's capabilities include:

- Mode V/U, L/S and HF/U Operation. Modes V/S, L/U and HF/S are also possible.
- Analog operation including FM voice.
- Digital modes. Store and forward operation is planned. Many speeds are possible but 9.6k, 38.4k, 57.6k and 76.8k bps are the most likely.
- PSK31 repeater mode using 10-meter SSB uplink and UHF FM downlink.
- Four VHF receivers and two UHF high power 8 watt transmitters.
- Can be configured for simultaneous voice and data.
- Has a multi-band, multi-mode receiver.
- Can be configured with geographical personalities.
- Advanced power management system.
- Digital Voice Recorder (DVR).
- Active magnetic attitude control.

Technical Review

Echo's internal subsystems have received some refinements since they were described in the last article. Thanks to Michael Kingery KE4AZN we now have a really useful block diagram for Echo (Figure 2). There you will see that Echo is made up of:

- Four VHF receivers.
- A Multi-Band Multi-Mode Receiver (SQRX).
- Two UHF transmitters.



Figure 1
Project Manager Dick Daniels, W4PUJ, watching over Integration Team Leader Jim White, WD0E, at SpaceQuest on 18-Dec-03.

- Six demodulators and 2 modulators.
- RF switching, RF cabling and phasing networks.

Not shown in this diagram are:

- Integrated Flight computer (IFC).
- Batteries, BCR, Regulators.
- Wiring harness.
- 56 channels of telemetry.
- Magnetic attitude control.

and to test the hardware. A great deal of the software had already been written but needed to be tested on the real hardware. Additional software had to be written while on site with the hardware.

Harold's primary objective was to get the Spacecraft Operating System (SCOS), kernel and AX.25 protocol stack running, along with the file system that implements the PACSAT Protocol Suite. This was accomplished quickly on Monday. Testing on those components continued throughout

Bring Mike up to speed on software generation and satellite operations. Accomplished.

Turn development of the ground command and telemetry software over to Mike. Accomplished.

Get the telemetry software in the housekeeping task (PHT) working - 90% done.

Calibrate all telemetry points - 95% completed.

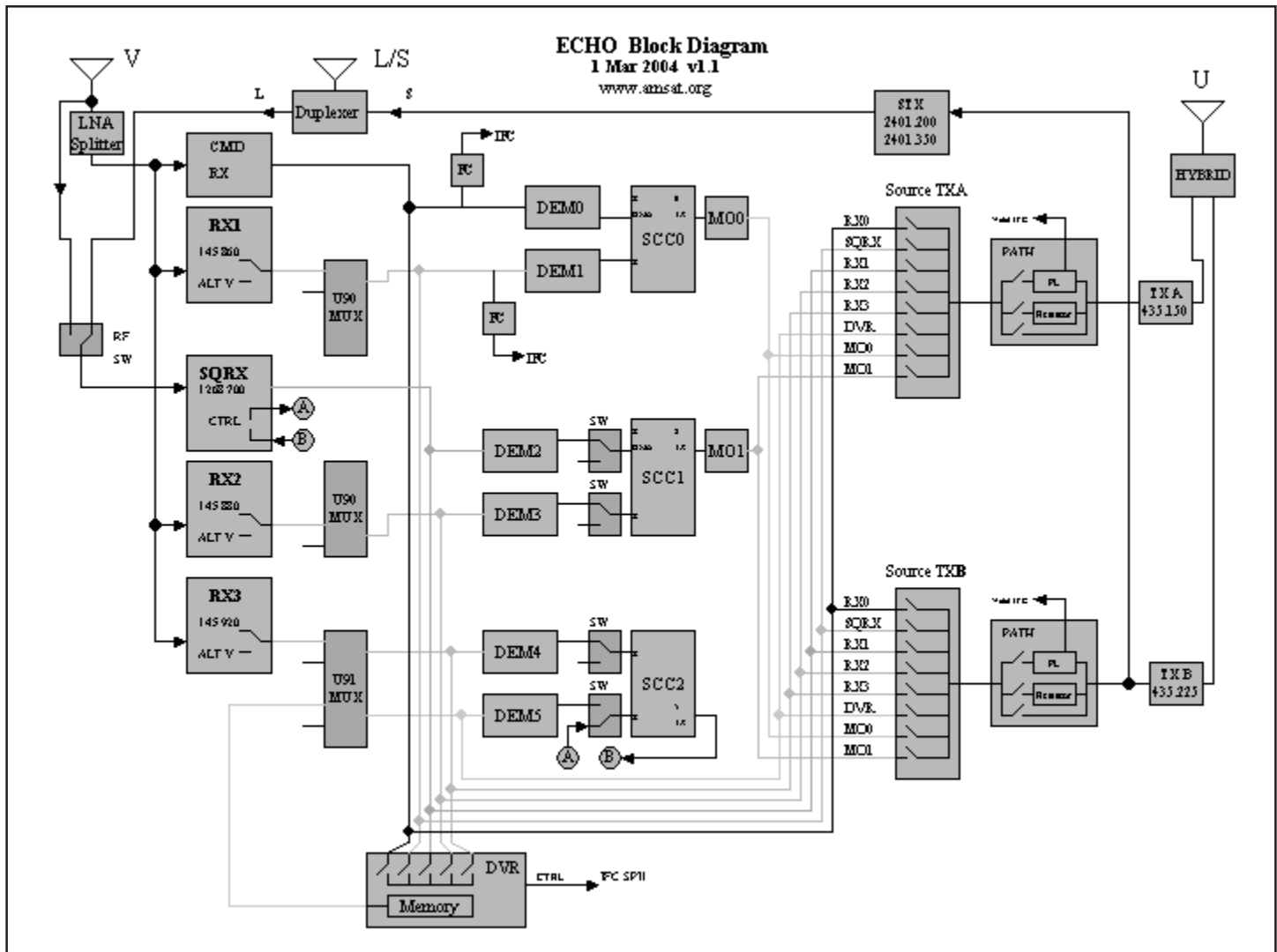


Figure 2
Echo Block Diagram by Michael Kingery, KE4AZN

The Integration Process

Did you ever wonder what happens during one of these marathon integration sessions? What follows is an edited version of the summary report authored by Jim White, WD0E, describing the two week integration activity during December.

Jim White, WD0E, Mike Kingery, KE4AZN, and Harold Price, NK6K, gathered at SpaceQuest in Fairfax, VA on December 8th to continue software development for Echo

the two-week period, but their early implementation enabled further software testing starting immediately after Harold departed Tuesday afternoon.

The primary objectives for the testing period, and the results achieved, were as follows:

Test all hardware - 90% of the hardware was tested. Two minor problems were found and corrected. Some hardware remains untested due to lack of time or lack of software.

Test over RF links. Some testing was accomplished but much more needs to be done.

Establish all initial settings for the hardware. Completed - 46 items must be initialized on startup.

Create a boot loader and initial housekeeping task and burn them into ROM. Completed.

Test all modes. All modes except high-speed data were tested. Recordings were made of





Figure 3
Jim White, WD0E, Harold Price, NK6K, Bob Bruhns, WA3WDR, John Teller, N4NUN and Mike Kingery, KE4AZN showing us that an integration team needs fuel too. Photo by Mark Kanawati, N4TPY.

voice contacts through the satellite on both V/U and L/S modes.

Gather pre-launch telemetry for analysis - 90% completed.

Get the flash memory working. Not completed.

Establish, burn, test and solder in the fire codes. Completed.

Test the CTCSS filtering. Partially completed.

Develop and test a small portable ground station for remote testing. Partially completed.

Test the Windows version of the Ground Station program (ground end of the boot loader). Partially completed.

Important Findings

The two downlink frequencies we initially chose are too close together for some operational modes. New operational frequencies were chosen and have been submitted for coordination. [These new frequencies are reflected in this paper.]

With the exception of two small problems found and corrected, the hardware was rock solid.

We were able to add two jumpers to the Integrated Flight Computer (IFC) board to connect the 'valid' tone signals from the CTCSS decoders to IFC I/O inputs. These can be sensed and used to activate the transmitters for FM repeater operation if desired.

We made modifications to the IFC to move the SQRX receiver to the second SCC port that is equipped with DMA. This will

facilitate high-speed digital uplinks, particularly on L-Band.

A large number of interrupts from receivers hearing noise continues to be a problem (as it has been on all 9k6 digital uplink satellites). A method was tested that completely solves this problem but precludes digipeating.

The amount of current drawn by the UHF transmitters falls off approximately linearly with the output power setting. However, even at a low setting the current is enough that judicious use of the transmitters will be necessary, including perhaps scheduling, CTCSS keying, low power, and/or power management software.

The Battery Control Regulator (BCR) function to reset the IFC when the battery voltage sags was not a good fit for this mission and was removed. The function that does a complete power cycle (including the IFC) when the battery is much lower was left in as a fail-safe battery protection measure.

Issues

The SSB uplink via the SQRX was garbled. This may be due to the close proximity of the transmitter. This will require further testing.

Some intermittent problems have shown up in transmitter power and CTCSS keyed operation when running in the boot loader.

Some false triggering of the CTCSS decoder was noted. It is unclear how that will effect operations or the power budget.

Action Items

Build the temperature decode software.

Test the RF links from a distance to get a more realistic test.

Perform calibration of torque rod feedback, transmitter power output, transmitter current draw, SQRX speaker and received signal strength indicator, BCR low voltage line current and 3.3V line current.

Fix the telemetry points that are not working.

Write and test torque rod automatic control.

Test and integrate final S-band transmitter hardware and test/calibrate telemetry points.

Test battery management flight software.

Write and test the transmitter CTCSS triggered keying software.

Test high-speed data uplinks and downlinks.

Write and test BCR set point code.

Test SQRX 9,600 baud uplink.

Glue on reflector cubes. These are a new experiment that will facilitate laser tracking.

Test for reported variation in transmitter output power from boot loader.

Write and test battery current decode software.

Create the 'final' telemetry list and publish the results so all users can decode Echo's telemetry.

Create a free telemetry decoder program and make it available to the users.

Obtain and test a fully developed Ground Station program from Skip.

Get more time on all the hardware.

Finish the command software.

Complete and test a small portable digital ground station for remote testing.

Further test SSB up via SQRX.

Measure S-band power consumption.

Change the CTCSS decode tone and test.

Test the SQRX and VHF receiver-1 input lines and adjust the software (these lines had been switched).

Further test the digital uplinks without the frame search mode and with real antennas on the receivers.

An additional goal for Harold was to create software to utilize the flash memory for program storage.



Figure 4
Photo by Mike Kingery, KE4AZN, of his satellite station set up at SpaceQuest for RF testing with Echo. Great signals from across the room!

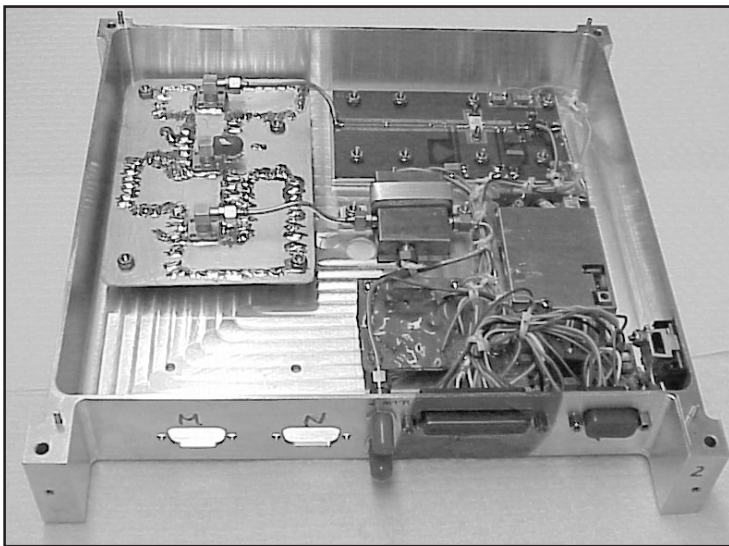


Figure 5
Echo's S-Band Flight Hardware. Chuck Schultz, KE4NNF, designed the exciter and Harold Sanderson, KT4XK, designed the power amplifier. Lou McFadin, W5DID, mounted and wired the modules. Photo by Stan Wood, WA4NFY.

Post Integration Work

As this is written (in mid-February) work continues on the Echo satellite. Action items are being resolved and the satellite is working very well.

The CTCSS tone has been changed to 67

all of the false triggering that was seen during integration testing. Among other advantages it will reduce power use.

Jim has found and eliminated several bugs in the flight software, mostly in the telemetry area.

Hz to make it the same as SO-50. Jim implemented software that samples the 'valid tone' line every second and keys the transmitter when it hears one. The hang time is 10 seconds. This is functionally equivalent to a terrestrial repeater with a kerchunk filter and a 10 second tail. This eliminates nearly

An interaction between various modulator settings has been fixed. Each setting is now completely independent.

Mike has made significant improvements to the ground station command software and has started on the telemetry decoder. He added the tricky code for the temperature calculations and it works fine. We should be able to release the telemetry definition preliminary file soon, which will be done through the Echo Operations Committee.

Stan reports they are nearing completion on the final S-Band flight hardware.

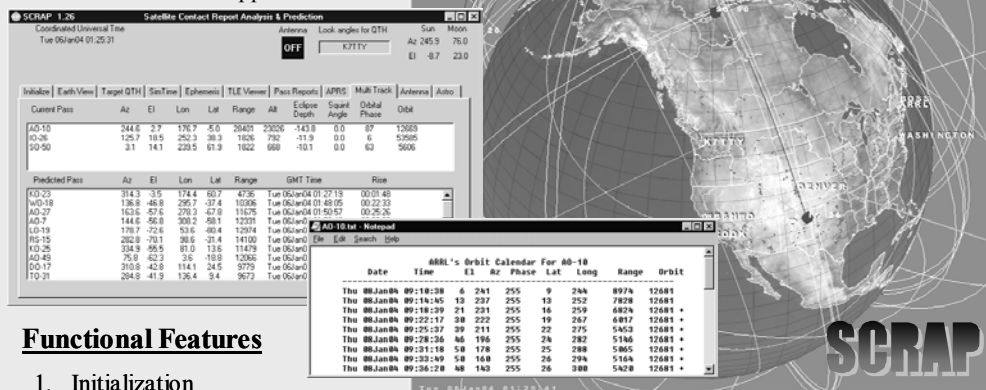
Skip completed the last of the features in the Ground Station program.

The HF/2-meter signal splitter, RF switch and the active FET preamp have been finished and installed. These support the use of the SQRX on both L-Band and other bands, such as 10-meters.

The dual band L/S antenna is finished. The L/S band antenna is shown in attachments. It is an open-sleeve design and works like a 1/4 wave stub on both bands. The center element works on L-band while the two stubs work on S-band. The entire antenna mounts on a male SMA flange mount connector. All parts are gold or silver plated brass. The

Satellite Contact Report Analysis Prediction

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4. Date/Time Simulation
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7. Pass Reports
8. APRS display
9. Multi-Track display
10. Antenna rotor control
11. Astronomical prediction

Performance Features

1. Contact Prediction / Reports
2. SGP/SDP ephemeris prediction
3. Real-time 3-D visualization
 - a. City, country, satellite labels
 - b. Lakes, rivers, islands
 - c. National boundaries
4. Over 25 Earth texture overlays
5. APRS station display
6. Multiple ground station support
7. Antenna rotor Az/El control
8. Internet updates
 - a. Two line orbital elements
 - b. APRS station locations
9. Astronomical data (Planets, moon)
10. Simulation

Recommended minimum processor

1. Windows 98 or better
2. Pentium Processor 500 MHz or greater
3. 256 MB RAM
4. Graphics accelerator card desired
5. 1024 x 767 resolution recommended

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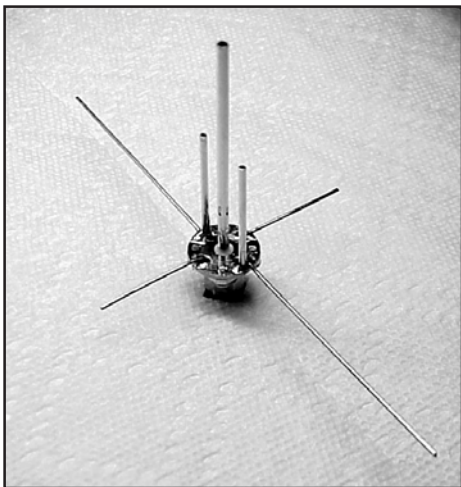


Figure 6
Dual-band L-Band and S-Band antenna
designed by Stan Wood, WA4NFY.

screws are stainless steel. It looks like the radials on the L/S antenna will be 1/2 inch or more above the solar cells. As an additional precaution, SpaceQuest has decided to put cover glass on these cells.

Late Breaking News

Stan has completed the design and construction of the splitter + preamplifier that will allow the 18 inch whip antenna to be shared by the SQRX multiband receiver as well as with the 2-meter uplink receivers. On Saturday February 14th an integration fit check was successfully performed to ensure that this new module will fit into the receiver tray, as it is mounted on the bottom of the Echo's top cover, directly above and extending into the receiver tray.

On Thursday, February 19th another fit check of the receiver tray was successfully performed, this time with all the modules including the splitter + preamplifier and the Digital Voice Recorder (DVR), which is a multi-board stack. This is the first time the DVR has been inside the receiver tray.

Launch

Echo's launch is now planned for summer 2004. The launch will be on a Dnepr LV (SS-18) rocket from the Baikonur Cosmodrome in Kazakhstan.

Volunteers

Special recognition is due to the following for their contributions and support during the integration phase of the Echo project:

Jim White, WD0E, for his technical contributions, leadership skills and for the many hundreds of hours he has invested as the integration team leader. Jim's contribution cannot be overstated.

Mike Kingery, KE4AZN, for his on-site support of integration testing including the

loan of his satellite station, and for developing command and telemetry ground station software.

The SpaceQuest team has provided great support, especially Mark Kanawati, N4TPY, and Dr. Dino Lorenzini, KC4YMG, who are also AMSAT members and volunteers.

Harold Price, NK6K, for his donation of the Spacecraft Operating System (SCOS) kernel and file system and for his on-site support during this effort.

Bob Diersing, N5AHD, for his timely work on the boot loader.

Skip Hansen, WB6YMH, for his efforts on the ground station software.

Chuck Schultz, KE4NNF, Harold Sanderson, KT4XK, Lou McFadin, W5DID, and Stan Wood, WA4NFY, for their work on the S-band transmitter and L/S band antenna system.

The AMSAT project management team for their help and assistance, especially Rick Hambly, W2GPS, and Dick Daniels, W4PUJ.

David Bern, W2LNX, for his assistance with the ground station hardware.

Conclusion

AMSAT OSCAR-E ("Echo") has continued to evolve and mature. Nearly all of its modules are built and undergoing testing. The software is working well and being refined. Initial system integration is complete and action items are being resolved.

By this summer the Echo satellite should be in orbit providing communications services to the ham community and serving as a platform for testing new concepts in space communications.

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- ² "AMSAT OSCAR-E Project Status Update, A New LEO Satellite from AMSAT-NA", *The AMSAT Journal*, November/December 2002, pp14-17, Richard M. Hambly, W2GPS
- ³ "AMSAT OSCAR-E Project Summer 2003 Status Report", *The AMSAT Journal*, July/August 2003, pp11-14, Richard M. Hambly, W2GPS
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- ⁵ "AMSAT OSCAR E, A New LEO Satellite from AMSAT-NA", CQ/VHF, Summer 2002, pp13-20, Rick Hambly, W2GPS
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⁷ "AMSAT OSCAR-E Project Summer 2003 Status Report", CQ/VHF, Summer 2003, pp14-16, 80-82, Richard M. Hambly, W2GPS

Echo Telemetry Specification

by Mike Kingery
ke4azn@amsat.org

The Echo Command Team has recently released Version 1.0 of the Telemetry Specification for our new AMSAT-NA satellite. The document and supporting files are available for downloading from the amsat.org Web site. Look in the Echo section of the website. The document contains information that will be useful for the casual observer, telemetry enthusiast and software developer.

In the specification you will find details on each of the analog telemetry channels and I/O registers that are sent by the satellite via the digital downlink. That means, from the downlinked data, satellite users can check, among a multitude of other things, the status of the transmitters, transmitter power levels, battery voltages, solar panel voltages and solar panel temperatures.

Software developers can use this document to determine how to decode the data sent by Echo to write their own telemetry decoding, viewing and storing programs. A windows based software package, "tlmEcho", will be available before launch from the Command Team.

The Echo Command Team would like to encourage users to copy and save telemetry sent by Echo. The data will be extremely useful in monitoring the health and status of Echo. A location to upload telemetry data will be set up before launch of the satellite. Data received from all parts of the world will help the Command Team determine how to most effectively operate the satellite.



Additional P3E News

Peter Gülzow, DB2OS

Translation from German by John J. Bubbers, W1GYD

There has been gratifying progress on the P3E project. Currently the first modules are being completed. We hope that some of them will be integrated into the satellite by the time of this year's AMSAT-DL membership meeting. The membership meeting will take place in Marburg, so that we might have the opportunity to see P3E in the integration room either before or after the meeting.

Engine Mount

Since the well-known 400-N engine for OSCAR-10 and 13 is no longer usable on P3E, a completely new mounting had to be developed for the smaller 200-N propulsion system. In the meantime it has been completed and is ready for installation (Figure 1).

Solar Cells from RWE

Thanks to the support of the DLR, RWE Solar will present us with solar cells at no charge, which will be assembled at Astrium and mounted with glass covering. Two panels will be fitted with GaAs cells and five other panels will receive high-efficiency silicon solar cells. There will be somewhat greater electrical energy available compared with OSCAR-10 and OSCAR-13. RWE is the largest supplier of space-qualified solar cells, and we have the opportunity to test the latest technology under real space conditions. Last November we received a generous contribution in the amount of 10,000 UK pounds from AMKSAT-UK, which was designated for the funding of the solar panels. Again, our hearty thanks to the all of the AMSAT-UK members for this exemplary gesture; it represents the best tradition of P3D. The Danish AMSAT-OZ has also made a contribution of 2500 EURO available. We hope that other organizations will follow this example.

IHU-3 Status

Lyle Johnson and Chuck Green have completed the circuit and the layout for the new IHU-3 for P3E and P5A (Figures 2, 3, and 4). The first prototype has been built. The new IHU-3 is no longer a paper concept, but a reality. It is not yet operationally ready, however, since the FPGA's, which contain the largest part of the logic, must still be programmed. The IHU (Integrated Housekeeping Unit) circuit board is notably smaller at 100 X 150 mm than the old IHU or also the IHU-2. It has fewer discrete components, since many of these functions are stored in the FPGA building blocks. The two large IC components will naturally be used only in the engineering model, so that the FPGA building blocks can be developed and tested. The FPGA building blocks will be soldered solidly in place in the flight version and then can no longer have their program changed. The 241-pin connector is likewise intended for debugging and will not be available on future boards. Since these are early prototypes a few small mechanical modifications are necessary. The six memory building blocks are only loaded by four to test the EDAC error correction. The EDAC logic has to correct the error with each attempt. The various memory chips will be tested in the next two prototypes, and thereby fully test the EDAC logic.

Lyle Johnson will breathe "life" into the IHU-3 and test the hardware functions. After that it will be the software team's job to port the IPS software to the IHU-3. Since there have been several basic design changes in the hardware concept this is really no small task. The plan is to build two of these new

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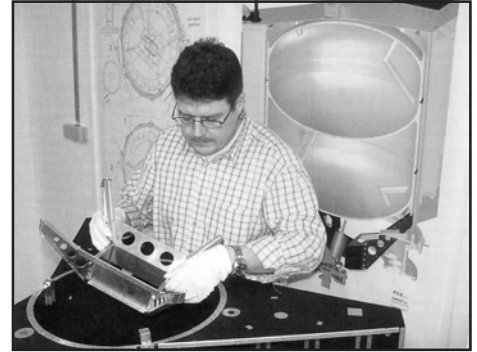


Figure 1
200-N propulsion system mounting

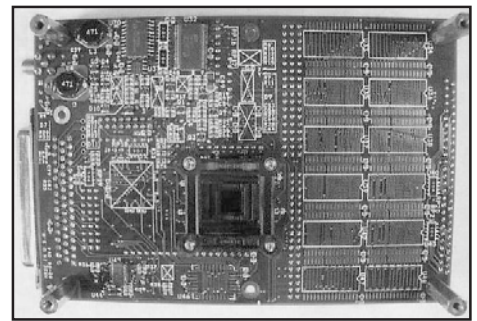


Figure 2
IHU Circuit Board

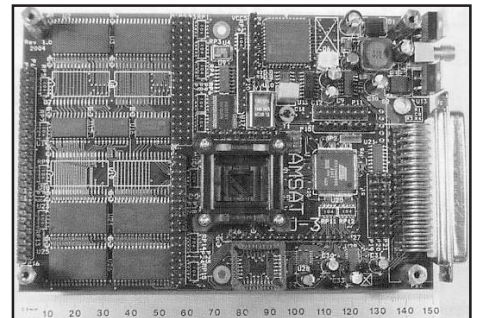


Figure 3
IHU Circuit Board

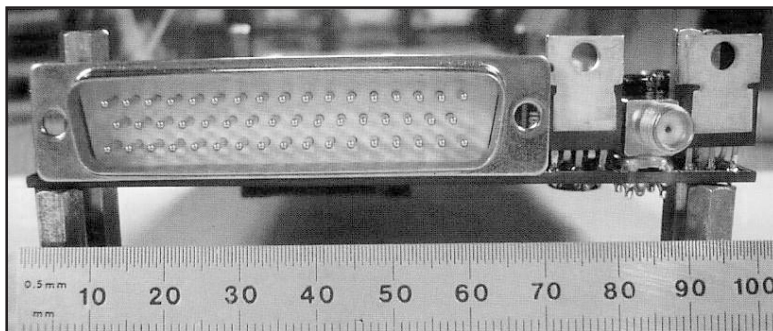
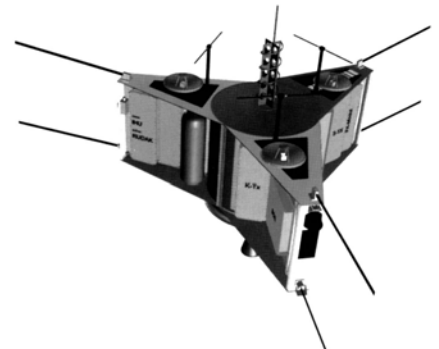


Figure 4
IHU Circuit Board Connectors



AMSAT is the North American distributor of **SatPC32**,
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DDE client programs
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- Includes a special version for ISS split-frequency operation.
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- Includes a non-graphical version and programs that output lists to the screen, printer, or a file.
- Interfaces with WiSP, with user-defined satellite switching priority.

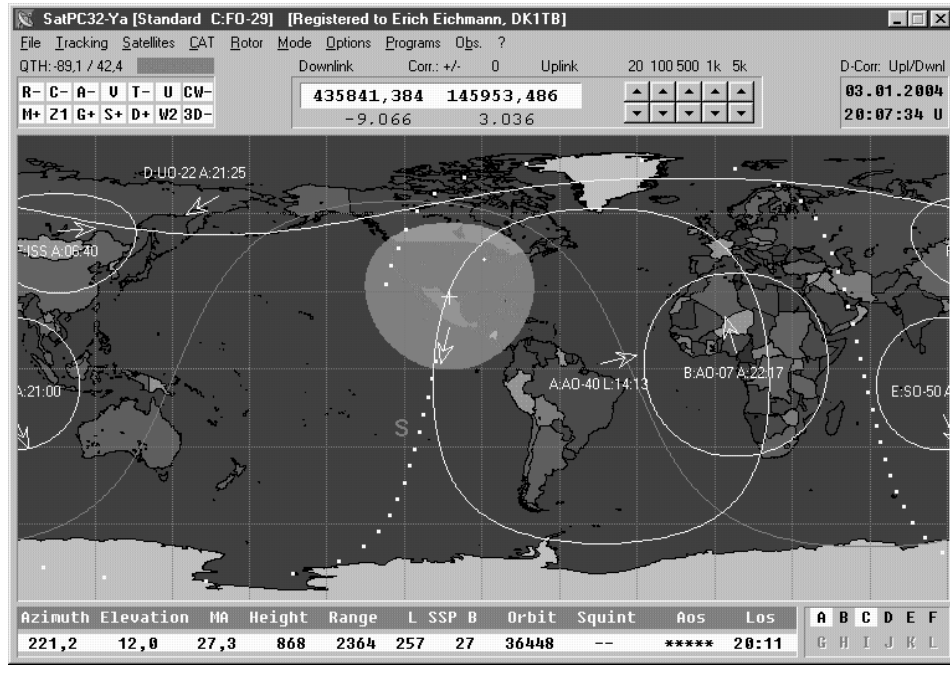
Price is \$45 for AMSAT members, \$50 for non-members, postpaid on CD-ROM.

A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm>

A registration password for the demo version is \$40 (members), \$45 (non-members).

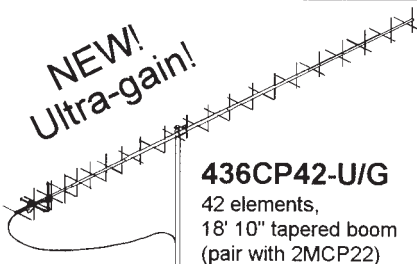
Order by calling 1-888-322-6728, or use the online shop at www.amsat.org.

The author, DK1TB, donated SatPC32 to AMSAT. All proceeds support AMSAT.



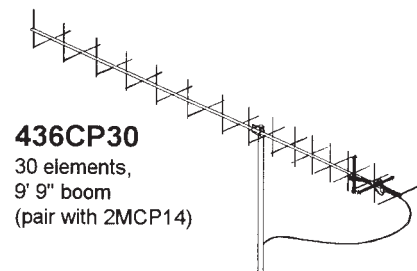
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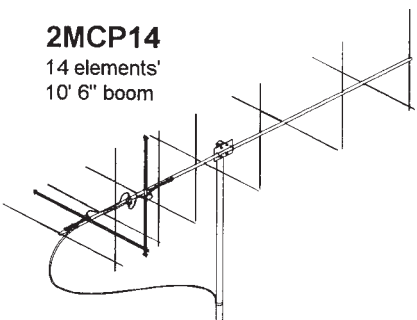
436CP42-U/G

42 elements,
18' 10" tapered boom
(pair with 2MCP22)



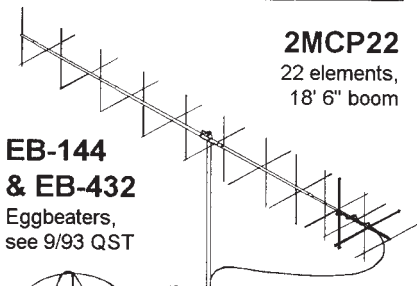
436CP30

30 elements,
9' 9" boom
(pair with 2MCP14)



2MCP14

14 elements'
10' 6" boom

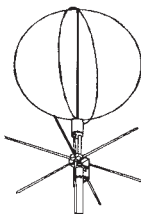


2MCP22

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AO-40 K-Band Experiences — August to October 2003

Viktor Kudielka, OE1VKW, oe1vkw@amsat.org

The AO-40 K-band transmitter was switched on from August 10 to October 31, 2003. During this period (except for a one week vacation in Greece) the majority of the visible passes were observed. Visible means here in the actual sense, since my neighbor's house allows me to work AO-40 at low elevations only if the azimuth is greater than 105 degrees. To the west the satellite disappears behind the hills of the Vienna Woods at elevations around 3 degrees. Otherwise, there are minor obstructions by a few trees in my own garden and, of course, other antenna-masts and antennas just next to the dish.

Equipment

The central fed dish of 0.48 m diameter (18.9") is equipped with a circular polarized feed horn integrated with a 3-stage preamplifier, built by Freddy, ON6UG. From there the preamplifier is connected with about 0.75 m of RG-400 to a coax-waveguide coupler, another 3-stage amplifier (MKU 243 WS), a wave-guide filter at 24.048 GHz, and a mixer (MKU 24 RXL) with a local oscillator (MKU 12 LO #4) at 11.376 GHz. The IF of 1.296 GHz is fed via 10 m of RG-400 and 30 dB attenuators to either an IC-1271 or an IC-970/UX-97.



Photo 1
Dish Antennas at OE1VKW

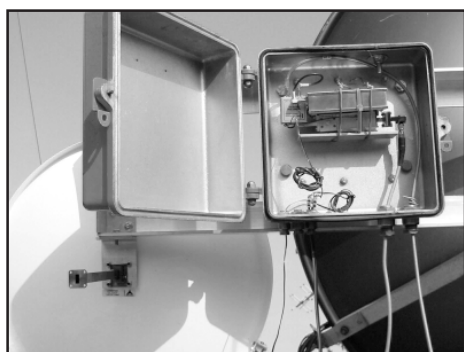


Photo 2
K-Band Receiver

Noise and signals are measured at audio frequencies with an AC multimeter (0.5 V full scale). Audio amplification is adjusted fully clockwise, and RF amplification is used for obtaining a proper level. AGC, although it cannot be switched off explicitly, seems to be non-active. The overall frequency accuracy, checked with harmonics from S and L band, is better than ± 10 kHz. The 24 GHz dish is mounted next to a 1.2 m dish (S-band) on a JRC/EGIS HAM antenna rotator. Due to some mechanical damage the 1.2 m dish turned out to be unusable on 24 GHz, while it is quite reasonable on 2.4 GHz.

Observations

An overview and summary of the observations is presented in Table 1. While initially the aim was doing QSOs, it was soon clear, that observing the beacon would clarify some of the difficulties experienced with the QSOs. Beacon frequency and strength was recorded. Details of the frequency behaviour will be presented further down. Beacon strength was significantly stronger when the passband was switched off. Since the "beacon only" period of 2 MA was changed from the beginning (MA 124 to 126) to the end (MA 132 to 134), the acquisition became more difficult. The limiting behavior of the K-band transmit path causes a lot of disturbances of the beacon by other stations (using the S band downlink) in the passband. CW signals were chopping the beacon signal dramatically and SSB signals were distorting it. Sometimes the beacon was disappearing completely in the noise, while the other stations were still R 5.

The influence of the squint angle on signal strength is not as obvious as one would

expect. The squint angle was calculated from the ALON/ALAT figures given in the header of the telemetry A-blocks. These did not always agree exactly with the (more precise?) figures from the YACE. YACE was always activated on orbits when the K-band activity was not in the visible range from Europe. Therefore a direct comparison was not possible. Second, the antenna rotator is not as precise as one would expect. Since a linear motion controls the elevation, some minor deviations of the elevation display occur. A full calibration of the display versus actual antenna direction has not been done. Due to the changing signal strength of the beacon, an optimization of the signal was not always very easy and probably not precise enough. For reasonable communications with a .5 m dish, the squint angle should be less than five degrees.

Finally, a weather report should be included in any description of K-band activities. Rain and snow make K-band activities definitely impossible, clouds and fog will have a significant impact.

Beacon Frequency

Figure 1 shows the measured beacon frequencies of ten orbits during the whole observation period. The frequency drift encountered is significant. At the start of the activity period the drift is around -5 kHz/min, slowing down to about -1 kHz/min, in one case down to -0.5 kHz (where at MA 182 Doppler shift was helping a lot). Of course, QSO signals are subject to the same drift, and following a SSB signal at 5 or 3 kHz/min (much more than on any LEOS) is quite a challenge.

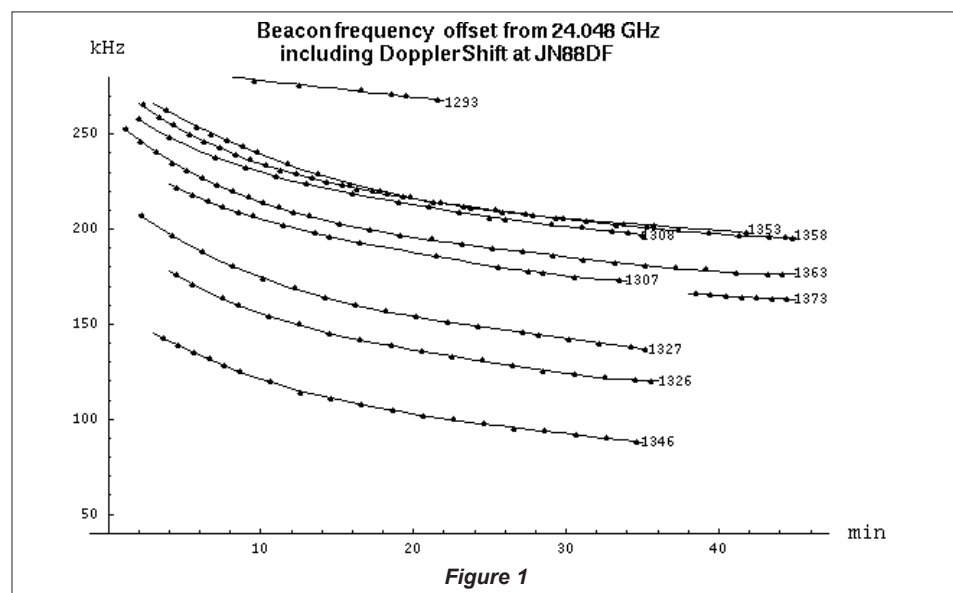


Figure 1



The frequency drift encountered at the ground station does not give any clues, therefore the Doppler shift has been subtracted. Figure 2 shows the result. We see now the actual beacon frequency, with a negative drift during the activity on each orbit as well as a negative trend during the whole period from August to October. There can be seen some standstill from orbit 1346 to orbit 1363.

The drift during each orbit can certainly be interpreted as a negative temperature drift, showing the warming up of the transmitter. There is no temperature sensor near the K-band transmitter and therefore we can only roughly compare the temperature of the satellite as represented by the heat pipes. Figure 3 shows the temperature of the ends of two heat pipes (telemetry data at the beginning of the K-band activity, MA 124 and 174 respectively), and we see quite a good match with the beacon drift. The behavior between orbits 1346 and 1363 gives a strong indication. Maybe during the next activation period the temperature drift of the satellite will be different, and we can verify this hypothesis.

Sun Noise at 24 GHz

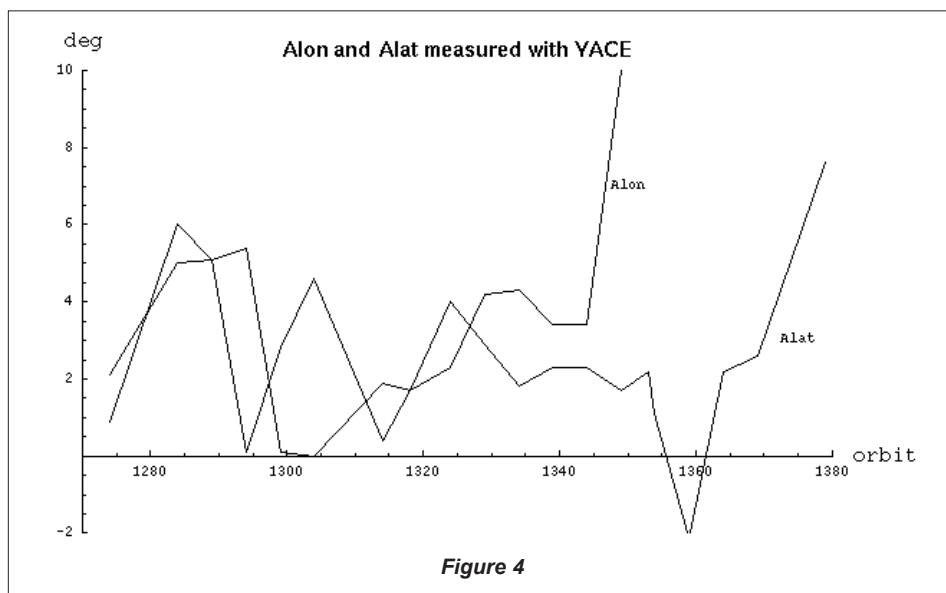
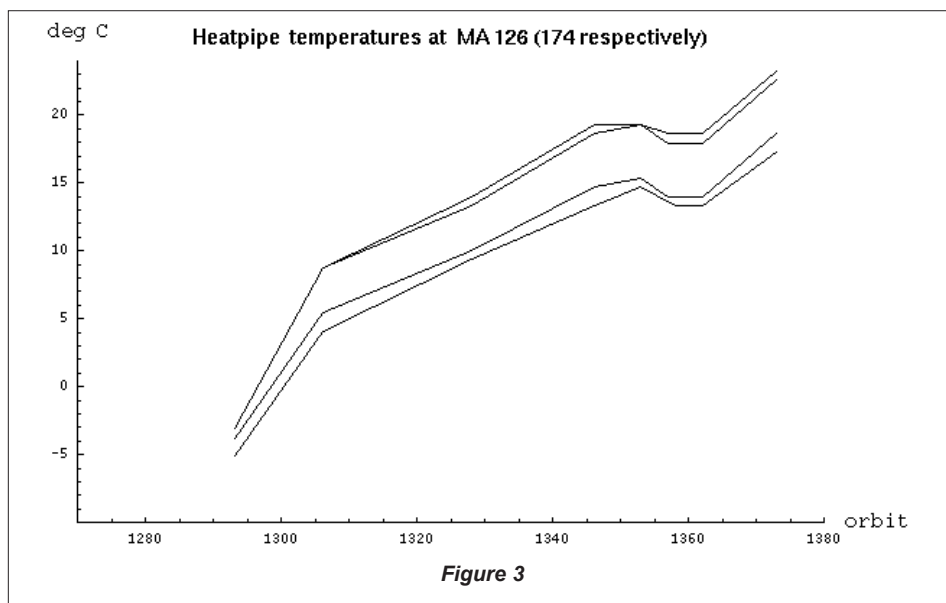
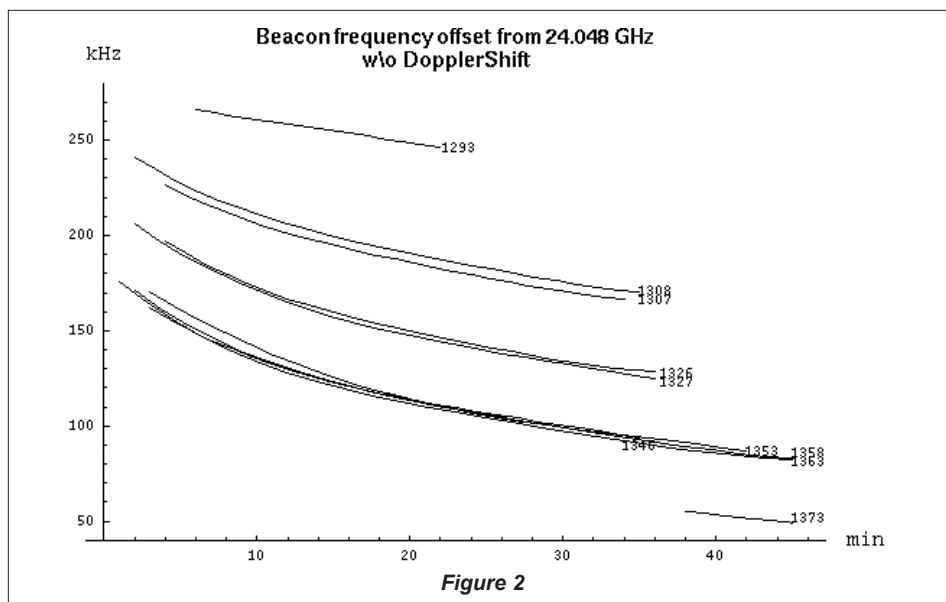
For antenna rotator calibration the sun was used on several occasions and obviously also the sun noise was measured. Values were between 3 and 4.5 dB, but no striking agreement with the solar flux measured at 2.8 GHz by the NRC/DRAO was found. Many more measurements, hopefully also from other stations, will have to be collected and analyzed.

QSO Planning

As mentioned previously, for stations with a 0.5m dish, the squint angle should be below five degrees. For example, for a connection from Europe to Japan, the apogee should just be over the middle point (Afghanistan), and also for that middle point, the squint angle should be near zero. If you consider the weather conditions on both ends, and consider also that one partner might be restricted to weekends, the occasions where contact can be made become extremely rare. Figure 4 shows the ALON/ALAT values (derived from YACE, stated accuracy ± 0.2 degree) during the time frame under discussion. Prediction of zero squint angle for a certain location becomes practically impossible.

Conclusions and Suggestions

QSOs with K-band downlink on both sides are still a challenge. An extension of the K-band transmitter operation (to 20 or 30 MA units) would offer multiple improvements. First, the temperature of the transmitter



Date	Orbit #	K-Band Transmitter On MA	ALON/ALAT	Squint Range/ Trend	Beacon Min/Max S/(S+N) dB		Remarks
					passband	single	
2003-08-12	1277	124/126/134	3/0		2 - 5	4 - 10	
2003-08-13	1278	"	3/-2				
2003-08-16	1282	126/132/134	5/1				
2003-08-17	1283	"	7/3	5.4 -> 3.7			QSO JA1ADN (receive S)
2003-08-19	1286	"	5/2				
2003-08-20	1287	"	5/2				
2003-08-21	1288	"	7/2	5.6 -> 4.0			QSO VK5DQG (receive S)
2003-08-24	1292	"	2/4		0	0 - 2	
2003-08-25	1293	"	4/3	2.5 -> 1.6	0 - 3	2 - 4	
2003-09-05	1307	"	0/1		3 - 6	5 - 10	
2003-09-05	1308	"	?/?		3 - 6	4 - 9	own down link 3
2003-09-08	1311	"	-1/0		0 - 1	2 - 5	
2003-09-09	1312	"	1/-1		2 - 4	3 - 7	
2003-09-09	1313	"	1/-1				
2003-09-12	1316	"	0/0	5.9 -> 4.5	0 - 4	2 - 5	
2003-09-16	1321	"	0/0	5.9 -> 4.2	0 - 2	2 - 5	
2003-09-17	1322	"	2/0	4.9 -> 4.2	4 - 7	6 - 10	SSB stations 5-6
2003-09-20	1326	"	1/2	5.8 -> 4.1	0 - 4	6 - 9	Min. Squ. 1.7, MA 148
2003-09-21	1327	"	4/1	5.9 -> 4.3	2 - 5	5 - 8	own downlink 2-3
2003-09-24	1331	"	1/0	6.5 -> 5.0	0 - 1	1 - 3	
2003-09-25	1332	"	3/0	5.2 -> 4.3	2 - 6	4 - 8	own downlink 3-4
2003-09-28	1336	"	3/1	8.2 -> 6.0	0 - 2	4 - 7	
2003-09-29	1337	"	4/0	4.3 -> 3.3	3 - 7	6 - 10	own downlink 3-4
2003-10-02	1341	"	2/0	7.1 -> 5.7	0 - 3	3 - 7	
2003-10-03	1342	"	4/0	5.6 -> 4.6	3 - 6	5 - 10	3 tlm blocks CRC OK
2003-10-06	1346	"	5/2	9.1 -> 7.3	0 - 2	3 - 6	Min. Squ. 1.9, MA 162
2003-10-11	1353	174/176/184	18/0	5.1 -> 4.9	0 - 3	3 - 6	
2003-10-15	1357	"	13/1	3.4 - 3.7	2 - 6	5 - 6	own downlink 2-3
2003-10-15	1358	"	14/-1	6.2 -> 8.1	0 - 1	1 - 2	
2003-10-19	1362	"	21/0	9.9 -> 7.7	0 - 6	2 - 5	
2003-10-22	1366	"	20/0	12.4 -> 9.7	0	0	cloudy
2003-10-23	1368	"	21/0			0	rain, snow
2003-10-26	1371	"	20/2			0	
2003-10-27	1373	"	24/1	8.5 -> 5.7	2 - 5		clear
2003-10-30	1376	"	23/0	15.0 -> 12.2	0	0	rain, fog

Table I
Data gathered from August to October 2003

would come nearer to equilibrium and Doppler shift would help to reduce the total frequency drift. Second, the probability of getting low squint angles, despite the problems with the mystery force in ALON/ALAT, would increase. And finally we should try to separate the S-band and K-band downlinks - switching off S-band is certainly not an option. How about promoting a slogan like "AO-40 S-beacon +/-40 kHz, 24 GHz-beacon +/-12 kHz"? 🌐



P3E News

... continued from page 13

IHU-3 modules into the P3E IHU module, because of the reduced space requirement. The second, redundant IHU-3 can take over the full functionality at any time based on the CAN networking, or it can take on other tasks during the Mission. Additionally, it was thought to use the new IHU-3 hardware for the RUDAK system. This RUDAK would further distribute the new FEC transfer method and would also be useable for the distribution of pictures from the cameras. No thought has yet been given to a PACSAT mailbox, however the FEC system would make a kind of satellite SMS possible with little cost on the ground.

Frequency Plan Coordination with the IARU

The IARU Advisory Board received the proposal for the AMSAT-DL coordination at the end of the year. The Board is now considering the multi-page document. A final confirmation of the frequencies, which are published on page 7 in this issue, was not available at publication time.

P3E Command Stations

AMSAT-DL is pleased to announce that the following international team is ready for the command operation of the AMSAT-P3E satellite. The call signs are naturally already familiar since they were active in the command operations of AO-40 and earlier satellites, and bring extensive experience. Good coverage is guaranteed because of the diverse geographic locations, which is important in the hours and days just after the launch. The following individuals are on the team:

Stacey Mills, W4SM, Virginia, USA

Ian Ashley, ZL1AOX, New Zealand

Paul Willmatt, VP9MU/G6KCV, Bermudas

Graham Ratcliff, VK5AGR, South Australia

James Miller, G3RUH, United Kingdom

Miroslav Kasal, OK2AQK, Czech Republic

Colin Hurst, VK5HI, South Australia

Peter Gülzow, DB2OS, Germany

Our command stations have played an important role in the success story of our Phase 3 Satellites, because after the launch their job really takes place. This kind of project could never take place without their dedication, experience and motivation and the "ham spirit".

Welcome on board! 🌐



Additional AMSAT Funding "The Challenge"

by Gunther Meisse, W8GSM, w8gsm@amsat.org
AMSAT LM: 594

After returning from a 20-year respite from AMSAT activities, I became convinced that AMSAT's future might rest with the development of substantial outside world, non-member, financing. Over the twenty years of my absence it became obvious that the prices to construct and launch satellites had jumped significantly. I concluded that I would run for the AMSAT Board and try to implement some changes that could help move our organization forward.

A number of issues needed to be addressed, including a quality Annual Report that could be used in fund raising. A more specific definition of just who AMSAT members really are, their age, their background and the like so that we could better create a "Fact-Set" and an "Opinion-Set" to better explain and define our membership to potential outside donors. Next, we needed a vehicle to gather, invest and direct the use of foundation donations that would be satisfactory to the donors. In addition, we needed a "Case for Support" that would explain the good works of AMSAT in a fashion that the outside world could understand and appreciate.

To date we have completed our **2003 AMSAT Annual Report**, which is available on the AMSAT Web site, and in glossy stock for use in the outside world. It is in full color and within 12 pages, gives a brief but concise view of our good works.

At the October 2003 Board of Directors meeting in Toronto, the Board gave overwhelming consent for the creation of the **AMSAT Endowment Fund**. Following Toronto we have completed the Endowment Fund documents including a complete set of Policies, Regulations, Duties and Rules, all of which have been passed by the BoD. Those interested in the full document can find it on the amsat.org Web site. The Endowment Fund Committee is comprised of the AMSAT President, Executive Vice-President, Treasurer and not fewer than two additional members of the Board of Directors selected annually by a vote of the Board. Additionally, the President may appoint no more than two members to the committee who are not Board members but bring special expertise to the committee. In mid-February 2004, President Robin Haighton appointed Gunther Meisse and Barry Baines to serve until the 2004 Annual Meeting.

The Critical Responsibilities of the Endowment Fund are as follows:

1. To develop creative plans and activities for continuing financial support of the strategic (long term and short term) mission and goals of the Corporation.
2. To encourage philanthropy for the support and encouragement of the activities of the Corporation from a variety of fund raising sources including, but not limited to grants, corporate, organizational and individual charitable gifts.
3. To develop a permanent endowment for the Corporation with a variety of contribution options, including operational funds, unrestricted funds and restricted funds by current and deferred giving opportunities.
4. To provide a variety of planned giving vehicles and opportunities for donors with varied interests and at varied levels of giving to support the mission and goals of the Corporation both now and in the future.
5. To assess and respond to emerging and changing needs of the Corporation and to serve as a resource and catalyst for charitable fund raising activities to support such needs.
6. To account to the Board of Directors of the Corporation semi-annually, or at specific intervals, upon request of the Board of Directors, as to the status of the Endowment Funds and the respective fund categories, including a report of the income and principal thereof.
7. To review and implement the general policies for the acquisition, division, use, investment and administration of the Endowment Fund to assure the best use and orderly administration of the Fund and to provide a continuing viable guideline for the Committee and the Board of Directors of the Corporation.
8. To maintain such policy or policies that will create an increased interest and confidence in the Endowment Fund with the Corporation, its members and the general public and maximize and encourage future gifts and bequests to the Endowment Fund.
9. To initiate such plans, activities and publicity to generate gifts and bequests and provide such information as may be

necessary to potential donors advising of the Fund categories available and the uses and purposes thereof.

10. Other than providing an income source for the operating budget from the Endowment Fund, the Committee shall not be responsible for the general raising of revenues to be used solely to fund the annual operating budget of the Corporation.

Over the coming months you will be hearing much more from the Endowment Committee as we make you aware of opportunities for you to support your AMSAT.

We have nearly completed the **"Membership Profile"** questionnaire, which will be mailed to four hundred (400) randomly selected members to gather facts and opinions. The questionnaires should go out within the next month with tabulation to be completed within the following three months. The results of this effort will be presented to the Board of Directors as additional background information for their deliberations as well as becoming part of our fund raising efforts.

Finally, we have started work on the **"Case for Support"** which will be a narrative covering the history of AMSAT and its good works as well as its vision for the future and outreach programs that have the potential to better mankind. It will be structured like our Annual Report, in a form that includes lots of pictures and in a style that is easily readable by outsiders, who often will know absolutely nothing about ham radio or AMSAT. This project will take months to assemble, edit and refine after consultations with outside endowment funds and experts. Following the completion of the Case for Support we will gather information on specific funding sources and customize our presentation from our basis case for support, hit the road and attempt to develop additional project funding. Ultimately, it would be our goal to raise substantial funds that could be used as an endowment for the sole purpose of constructing satellites and paying for their rides. This would require millions within the Endowment. But, as you know, it will never happen if we all don't try.

We are making significant progress along a very long road, which will include some notable setbacks. With your help, and generosity, we can build on the wonderful heritage of AMSAT and take it to exciting new adventures. 🌐



MEMBERS GENERATE INTEREST AT MIAMI

AMSAT members generated interest in satellite operations at the Miami Hamfest on February 7th. An unknown bystander took these pictures with Jeff's (KB2M) Pentax digital camera.



Here are a couple of pictures from the Miami Hamfest, Feb. 7, 2004. Left to right: KO4MA, KG4EYB, KD4FRB and KB2M who set up an AMSAT booth. Great WX here.



Left is Jeff, KB2M, right is Drew, KO4MA, using our 817's. As the 817 isn't full duplex we used two: one for each link and using the Arrow antenna. It's nice to play with friends who have the same toys!

See Us at Dayton Booth #207
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A dialogue between the AMSAT President (Robin), Editor (Ed) and an anonymous former member of AMSAT. (edited)

[Robin] Hi Anon and Ed,

Many thanks for including me in this conversation. My comments are given below in italics. I hope this helps in showing some of the direction that AMSAT is moving, and may even convince Anon to change his mind and rejoin this wonderful group called AMSAT.

73,

Robin, VE3FRH

[Anon] copied his comments to Robin because this turned into a lengthy discourse about AMSAT.]

[Ed - in response to print format comments] Hi Anon, I am not sure anyone feels electronic publication is too radical. As I mentioned in an earlier e-mail to the BB, it doesn't matter to me as the editor. It is really up to the membership. I use PageMaker, by the way, to pull it together so it starts out in electronic form anyway. Only once the printer receives it - again electronically - does it go on paper. Seems funny that we do it that way.

73,

Ed Long

WA4SWJ

Editor, The AMSAT Journal

[Robin] Ed is quite right that is the way it is currently done. We are now investigating the possibility of doing both electronic distribution and of paper distribution with the ultimate aim of substantially reducing the paper distribution. However let me add that a significant portion of the membership do want the "old fashioned" paper version. This was demonstrated when recently a sister technical organization stopped paper distribution and almost immediately lost a large number of members. Thus our thought is to "phase in the electronic version and carefully phase out the paper version".

[Anon] Ed,

Thanks for your note. It really doesn't matter that much to me any longer because I've let my AMSAT membership lapse. The reaction to the suggestion of considering an electronic distribution of the AMSAT Journal is just another example of why I let my membership expire. It seems that the direction that AMSAT is pursuing just doesn't overlap with my interests at all these days.

I've been a ham since 1975, when I got my license in high school. It was pretty cool stuff back then, neat technology to play with. However, it seems that Amateur Radio as a whole resists change like no other organization I've ever been part of. I was there for the whole "No-Code" license debate; it was just astonishing to me.

[Robin] Yes, me too. However, ham radio can still be really neat stuff. What other hobby organization do you know that can say it has really kept up with technology, both electronically and with the fantastic advances in materials? Who has a better launch and success record? Who else has branches in all major countries and co-operates on an almost daily basis with national and international organizations like NASA and the European Space Agency (ESA)? AMSATs have launched over 50 Satellites from many AMSAT organizations, and in the last few years since AO-40 was launched 10 more are now in orbit.

[Anon] One would think that the population of members in AMSAT would represent one of the more forward-looking segments of the Amateur Radio hobby.

[Robin] Are we meeting our mandate? - I think so. That mandate is to build and launch satellites for the benefit of the Amateur Radio Community, and to

keep them informed on progress. For the past 35 years we have sent out a magazine every 2 months and for the past 3.5 years a monthly electronic letter has been sent to the AMSAT-BB, not to mention that every week the ANS Group puts out a newsletter electronically. Personally I am one who would print out the Journal every 2 months if it came electronically - you might ask why? The answer is because it contains so much good knowledge that I need to keep a copy quickly available. A hard copy, properly filed, is easy to find and read.

[Anon] If that really is the case, then the hobby is doomed. The average age of hams is aging towards death. Frankly, if I were in high school today, as much as a geek as I was almost 30 years ago, I'd be hard pressed to understand the attraction of the hobby. In a world filled with cell phones, the Internet, personal computers with more computational power than was used to design nuclear weapons, it's hard to understand why a teen would be all excited about pushing FM voice through a LEO satellite.

[Robin] On a personal basis, I would agree with you on that, particularly if you only see it as that, but if you see it as a tracking challenge plus an antenna challenge, etc then there is more to it. Have you ever talked to Europe on AO-27? I did when the angle of the antenna was zero degrees as seen from both sides - another challenge.

Our new satellite will have additional challenges including L/S band operation in LEO. Consider the Doppler challenge of that. Other experimental operations will be available - pushing the technical limits. Just the thing for a true "Geek", will you rejoin and operate Echo?

[Anon] Try to explain swapping QSL cards for contacts; geeze, why not have the guy just send you email?

[Robin] We do send QSL cards by e-mail. They are the confirmation that you managed the impossible, from the person you did the impossible with! I gave up HF QSLs a long time ago, but a good Satellite contact in an unusual mode is always worth a QSL card.

[Anon] And I had to chuckle at "straight key night" on the satellites. Why not "PSK31 night" or something that reflects the century we're living in, rather than the Same Old Thing. The nostalgic aspect is lost on most folks these days. It's just one of those funny things the old guys do; just humor them.

[Robin] So, like you, I have not done "Straight Key Night" Yes, CW is to me old fashioned and I have worked PSK 31, however I don't go around decrying those who like CW, and if they wish to do it at the New Year, good luck to them. I have better things to do. However they are not in any way upsetting me or interfering with my enjoyment of the hobby.

[Anon] A few months ago I sent a message to the list when the discussion of broadband over power line was raging, as well as some pressure on the 5GHz amateur spectrum for additional unlicensed data operation. What would be the greater benefit to everyone? Unlicensed Part-15 use of 2.4GHz has done much more to advance the state of the art with 802.11 wireless radios than amateurs have done. I suspect the same would hold for 5.8Ghz.

There may be less activity by ham radio on these bands than by other means but I think a true examination of the development of the spectrum would show that in spite of there being many unlicensed part 15 users their individual contribution to the frequencies of L, S, C and higher bands is very small compared to the use by AMSATs and the various ham organizations who have opened up these bands for commercial use. Throughout the history of ham radio from the earliest days we have been at the

forefront of wireless communications, both hardware and more recently with software (PSK 31?)

But that spectrum is "ours", and regardless of the issues, it's got to be "wrong" to give it up to "them". Never mind that the amateur community represents essentially an unnoticeable [But very necessary and effective] constituency. As a taxpayer and consumer, I'm pretty sure I'd rather have cheaper and higher performance wireless LAN to use at home. (Mind you, I've also a professional interest in this, but that's because the unlicensed radios sure hold more interest for me than Amateur Radio operation on those same bands.) [Ah-ha .. there is a bias.]

I suggested that the opportunity here was to recognize the political reality of the situation and turn it to our advantage to lobby for less restrictive emission requirements on those and other bands.

[Robin] I am not sure what you mean here. We the hams are almost unrestricted. The Part 15 users are also fairly unrestricted, but it is necessary that they don't interfere with other users. That includes themselves, can you imagine the chaos that would result if all 802.11x equipment was allowed 1 kw EIRP? Nobody would be able to communicate with anyone. At least hams have knowledge of the systems and can operate with responsibility. Most unlicensed operators have no knowledge and hence no responsibility on this particular subject. I am aware of at least one person attaching a 2-meter diameter dish to his wireless modem. Is that responsible? Fortunately his knowledge was such that he fed it through a lengthy line of RG59. (Ignorance can sometimes work on our side.)

[Anon] Amateur Radio is making itself less and less relevant as time goes on, and AMSAT has turned into another platform for DX contests and the same old ham radio that had no attraction for me 30 years ago.

[Robin] Did you read about Phil Karn's improvements to receiving the telemetry from AO-40? Or have you tried the 24GHz down link? Maybe you could be one of the very few people who have communicated at this frequency. Could you develop an antenna system to work 24GHz without the gear backlash being a problem? There are so many challenges awaiting you that I could not number them all. Just keep looking at the opportunities. The DX side of satellites only proves that you are capable of making these technical installations or changes.

It sounds to me as though you are no longer a Geek, but are tired of technology and looking for someone or organization to blame. Your technical "Get up and Go" has gone. Rejoin AMSAT and take the challenge.

[Anon] And I won't restate the whole debate on supporting the ARISS thing, which to my mind seems more about school contacts and NASA PR than Amateur Radio. I'm sure lots of folks really like the fine work that's been done with ARISS. But it's another example of the highly polarized difference in interests among the membership.

[Robin] So, we have many interests, what is yours? What area of interest can we involve you in? There is plenty for all.

[Anon] So, AMSAT has a problem because they're trying to be everything to everyone and can't really succeed in large part because the ranges of interests are so large.

[Robin] Sure we have plenty of interests, but they are all around satellites and space, including ISS and space science. Now we have VHF, UHF and shortly HF on the ISS, it is important to the membership that we have a variety of related technology. With only one or two we would soon become bored.

[Anon] Over the years, I have lived vicariously through AMSAT as a closet "rocket scientist" to get some insight on how these spacecraft are built and what it

A Dialogue continues next page ...



by Scott Lindsey-Stevens, N3ASA • n3asa@amsat.org

So far 2004 has been a busy year for the ARISS program. Students at three schools made contact with Commander Mike Foale on the International Space Station. Unfortunately a fourth, Armstrong Middle School in Flint, Michigan, had to be postponed to an as yet unspecified date due to the slight air leak aboard the space station in January.

The three schools contacted generated media interest in the program. Gilmour Academy's (Gates Mills, Ohio) contact on 2 January was covered by a local newspaper and the local Fox affiliate. Several media including BBC TV & World Service as well as BBC Radio Kent, *The Kent Gazette*, and Meridian TV covered the King's School contact on 28 January in Canterbury, England. Finally, James Bay Elementary School in Houston, Texas contacted the space station on 4 February. Last year, the ARISS program reached approximately 15,000 students worldwide.

In other news, the International Education Outreach Committee met on 8 January to discuss several items including negotiating ISS crew time for ARISS contacts, the Roy Neal, K6DUE, Commemorative Special Event, and the next ARISS International Meeting. Minutes from this meeting are posted on the ARISS website at <http://www.rac.ca/ariss/arisschm.htm>.

The ARISS team planned two engineering checkout passes for the Phase 2 Kenwood system. These checkouts are needed before the equipment can be used for a school contact. The Russian pass was accomplished on 2 February. The U.S. test was postponed due to the Progress 13P docking and unpacking maneuvers. The U.S. engineering team hopes to accomplish their tests sometime from mid-February to mid-March.

The Space Station's packet system has also

been up and running as of late 2003. The ISS is currently using the packet capabilities in the Kenwood D700 with the new ARISS antenna systems in the ISS Service Module. The station has been running reliably with lots of unproto/APRS QSOs after several packet-related parameters in the D700 were tweaked to optimize the packet system. Usually the station operates on 145.990 MHz uplink and 145.800 MHz downlink. From time to time the station may be switched over to the 145.825 MHz uplink with the downlink remaining the same. As always, the ARISS Team will endeavor to inform the Amateur Radio community about such changes via the SAREX listserv. Please be aware that amateur equipment will be turned off during EVAs (spacewalks).

The next ARISS International Meeting will be held the last weekend of March in the Netherlands. All the international teams will meet at this time to plan for the year ahead.

Finally, the ARISS team would like to congratulate 7-year-old Mattie Clauson, AD7BL, (formerly KD7TYN) for passing element 4 of the Amateur Radio license exams. She announced her achievement via the RS0ISS packet system and on the QRZ.com Web site. Further information may be found at <http://www.arll.org/news/stories/2004/01/29/1/?nc=1>.

We'd also like to thank the AMSAT community for your support. We highly value your feedback, especially through the SAREX listserv. 

A Dialogue - continued from page 20

takes to make such a thing work. I was really offended by the thread on the AMSAT-BB list a month (Subject: Secrets...) or so back regarding making the design details of the spacecraft available to members. I would be willing to fund a membership just as an educational vehicle to see how this stuff is done. But I "don't need to know".

[Robin] I agree this is a problem, however much of our earlier work is available through Stanford University. The problem with the Phase 3 satellites is that the designs are owned jointly by AMSAT-NA and AMSAT-DL. We would have to have their complete agreement to be able to provide that information. They do not want their information distributed. ALSO, the State Department classifies satellites as armaments and prohibits us from disclosing the designs of our satellites (ITAR Regulations). Although we are working to become a legitimate exception to the regulations, until that takes place, we must obey the laws of the land.

[Anon] The impression I'm left with is that I'm not a member, I'm just a funding source.

[Robin] I sincerely hope that every member of AMSAT feels that they are more important to the organization than "just a funding source". Being a member should involve you in the technology, help to keep you up-to-date and enable you to operate our satellites in whatever mode, and having fun. If you want to volunteer for an AMSAT job, then fill in one of our "Volunteer Forms" on the Web page, and we will try and fit you in to a suitable position. I am a strong believer that the more people who have AMSAT jobs the better for both them and AMSAT. Participation is a big part of enjoyment, at least that is why I joined the organization and look what happened!

[Anon] In the world that I'm a part of, open source software is a very significant contributor to my personal and professional life. I can see how stuff works, and I can easily contribute to it. AMSAT needs to get on this bandwagon too, if they expect to get "new blood" into the part of the organization that builds vs. just funds and this is the way to do it. Some strong policies on the part of leadership of the organization on the nature of contributions AMSAT would prefer (e.g., open and non-proprietary) would be welcome to change the culture. As it is now, I'm better spending my membership dues, and more importantly, my time contributing to these groups writing software.

[Robin] Much of our software has, in the past, been freely donated, but is proprietary software, which we have been asked not to distribute. Eagle will be different and most probably will be totally open source with the exception of the control codes.

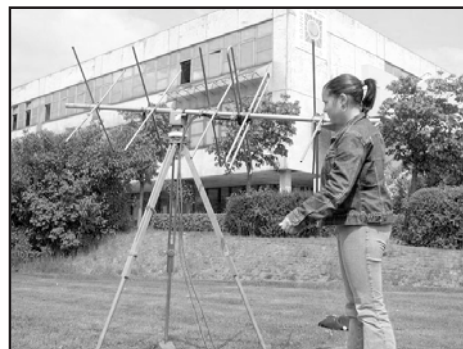
A Dialogue continues on page 31 ...



Sergei Krikalev, U5MIR, participates in the ARISS-Russia voice tests of the Phase II amateur gear aboard the International Space Station.



Students at Germany's Berufliche Schule des Kreises Nordfriesland line up to ask their questions of ISS commander Mike Foale, KB5UAC, as the controls of NA1SS during a December 2003 contact.



Also at the Berufliche Schule, a student checks out the ARISS Earth-station antenna before it's installed on the school's roof.



The following donors provided prizes for the October 2003 Annual General Meeting in Toronto, Canada. Thanks to all the donors that supported AMSAT so generously and congratulations to all the prizewinners! Please visit the web sites below to find the products that were donated.

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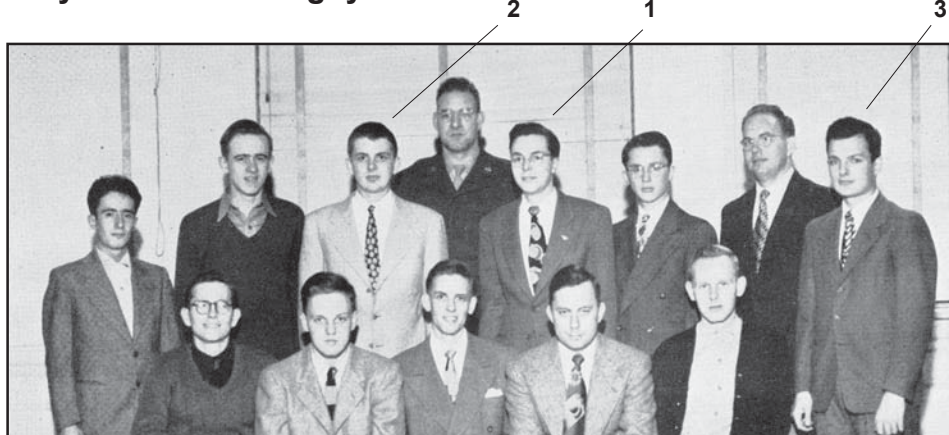
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Do you know these guys?



From the 1951 University of Maryland Yearbook - A photo of The University of Maryland Amateur Radio Association's membership taken in the fall of 1950. Future AMSAT people in the picture are:

1. Bill Hook, W3QBC
2. Bob Carpenter, W3OTC
3. Dick Jansson, WD4FAB

Bill Hook and Bob Carpenter volunteer and help out a great deal at the AMSAT office. Dick Jansson contributed significantly to the design of many AMSAT satellites.

P.S. - Your editor was only a couple of months old when this was taken!



An L-Band Helix Antenna Array

by Clare Fowler, VE3NPC, ve3npc@rac.ca

Abstract

For 23 cm (1269 MHz) SSB operation on AO-40 a nominal 1500 watts ERP of uplink power is required. This can be obtained with a low gain antenna driven by a power amplifier or alternatively, with lower power into a higher gain antenna. Following classical standard textbook design and utilizing available hardware and shop tools, the author has constructed four helical antennas in a square array, driven through a four-way power divider. Chain link fence fiberglass tension bars are used for the antenna and bracing frames. Aluminum ground wire is used for the helix conductor. This design provides an inexpensive durable lightweight array with relatively low wind loading. With a maximum input power of 10 watts into a feed line with about 2dB total loss, this antenna array has performed well, both operationally and mechanically, for over two years. A novel implementation of the quarter wave matching section makes for simplified adjustment of the SWR. Construction material, dimensions, assembly and testing are covered.

Introduction

The helix is a relatively broadband antenna and small dimensional irregularities have little effect on performance. This makes it

an ideal antenna for home construction. An antenna array comprised of four identical 27-turn right hand polarity helix antennas provides sufficient gain for L band operation into AO-40 with 10 watts of RF drive. Aluminum ground wire, carried by the local electronic chain store, is used for the helix conductor. Chain link fence fiberglass tension bars are used for the helix support boom and antenna cross bracing. These bars may be obtained in the fencing department of hardware and building stores. Aluminum sheet is used for the reflector. Sections cut from aluminum angle stock are used for support brackets. Stainless steel machine screws and nuts are used to prevent corrosion. To minimize losses, type N connectors are used on each helix, the four-way power divider and interconnecting cables.

Helix Antenna Match

The feed point impedance of a helix antenna is on the order of 140 ohms. A quarter wave matching section may be used to transform this to 50 ohms. To match 140 ohms to 50 ohms the quarter wave matching section must have an impedance (Z) of 84 ohms, where Z is the square root of 140×50 . The impedance of a circular conductor above a ground plane is defined by the formula: $Z = 138 \log 4h/d$; where h is the height of the

conductor above the ground plane, and d is the diameter of the conductor. Placing a conducting metal ground plane under the first quarter turn of the helix conductor provides a suitable quarter wave matching section. The width is not critical but should be several times the width of the helix conductor.

Quarter Wave Matching Section Construction

The ground plane for the quarter wave matching section is cut from a piece of hobby shop brass sheet. See Figure 1. With a compass draw two concentric 90-degree arcs on the brass, the first with a radius of 27 mm and the second with a radius of 52 mm. From the compass center mark draw two lines across the concentric arcs with a 90-degree angle between them. These four lines define a 59 mm length quarter circle ground plane that will be mounted directly under the helix. Cut or file a semi-circular notch in one end to clear the pin base of the N connector. Drill holes on each side of the notch to match the N connector mounting holes. The off-axis N connector location and orientation on the reflector plate is required for installation of the ground plane. For the ground plane to function, both ends need to be shorted to the reflector plate. A short loop of brass sheet or a piece of coax braid is soldered to the end of the ground plane. The other end of

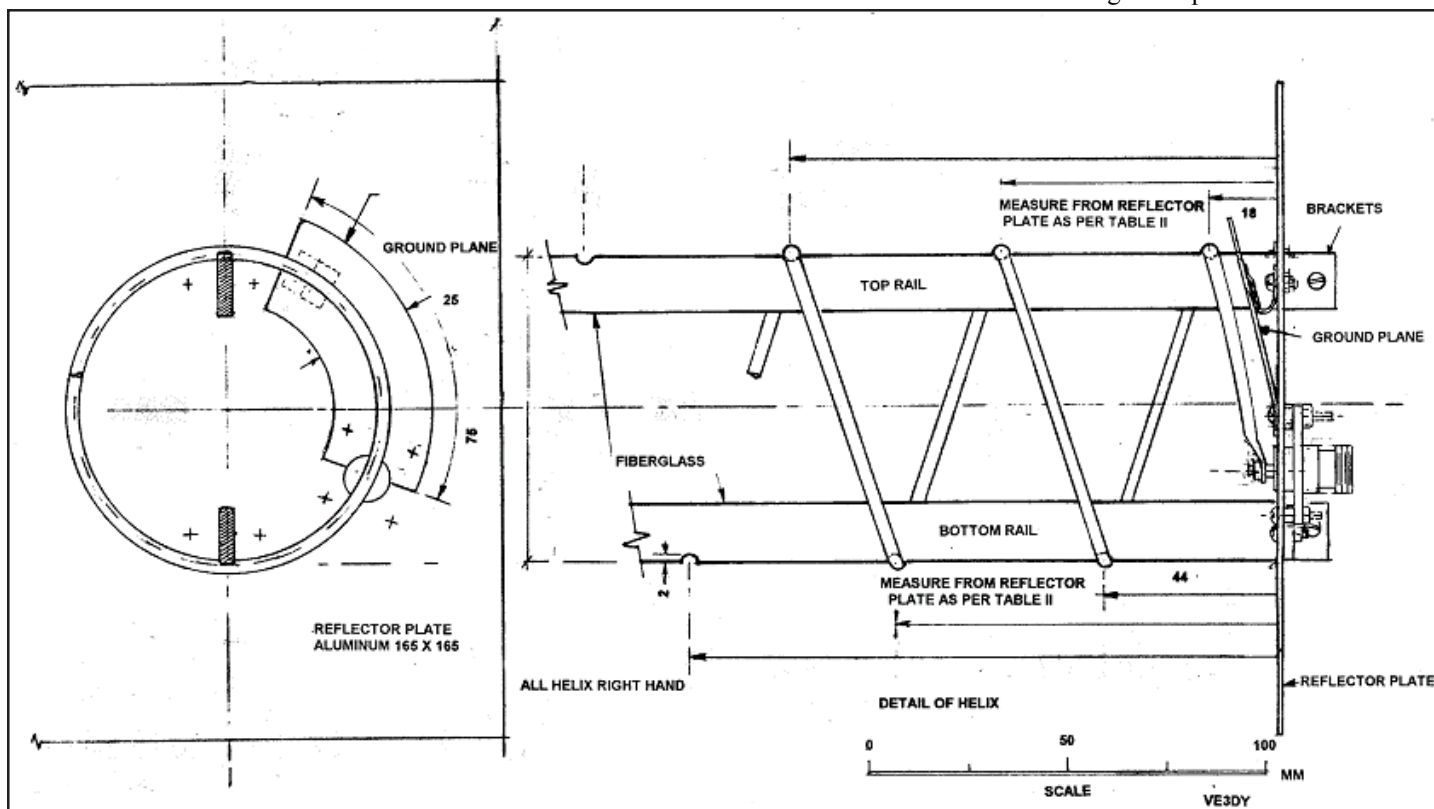


Figure 1 - Antenna Details - Reflector End



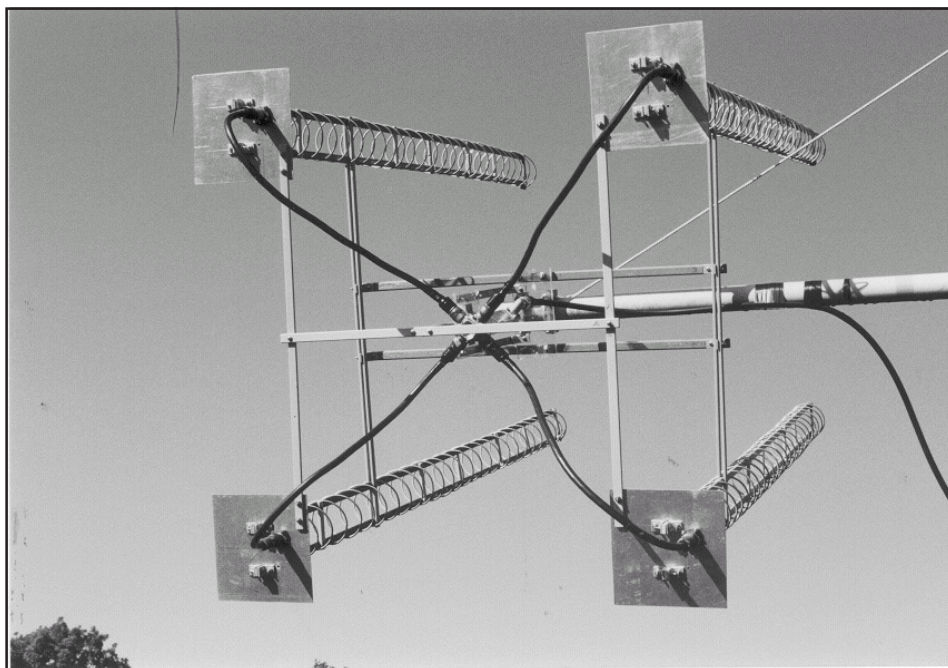


Photo 1
Photo of the Helical Antenna Array

the loop is fastened to the reflector plate with the machine screw that holds the boom angle bracket.

Helix Antenna

The helix dimensions are determined using the formula by Kraus in *The Satellite Experimenter's Handbook*. The circumference is equal to one wavelength

and the pitch angle is 12.5 degrees. Construction details are shown in Figures 1 and 2.

Two five-foot length fiberglass tension bars are used for the antenna boom frame held apart with cross braces cut from another bar. See Table I for positioning. The ends of the boom frame rails are fitted through cuts in

the aluminum reflector plate. Each boom rail is held in place by two angle brackets, one on each side, cut from $\frac{3}{4}$ " aluminum angle stock. A chain saw file is used to file angled notches in the boom rail bars into which the aluminum helix wire is fitted. To avoid cumulative errors, mark the position of each notch measuring from the reflector plate as indicated in Table II. Size the aluminum coil diameter by close wrapping it around a 65-mm diameter form. Wind the aluminum wire off the coil directly onto the form, without straightening it first. This way it stays pre-stressed, and will later spring out to the required 75-mm diameter when stretched to the correct helix length. Using a hammer, flatten the first 1 cm of the helix wire and drill a hole in the center of the flattened end to clear a 4-40 screw.

Trim off the half lip from the female chassis type N connector solder contact pin. Cut the head from a 4-40 brass screw. Dress one end to fit into the N connector pin by putting the screw into a power drill chuck and holding the edge of a flat file against it while it is turning. Solder the screw into the N connector contact being careful to not get excess solder up into the screw threads.

Bolt the N connector and the quarter wave ground plane section to the reflector plate. Extra screw nuts are used as spacers on the N connector so the first quarter turn of the helix is close to the ground plane and the reflector.

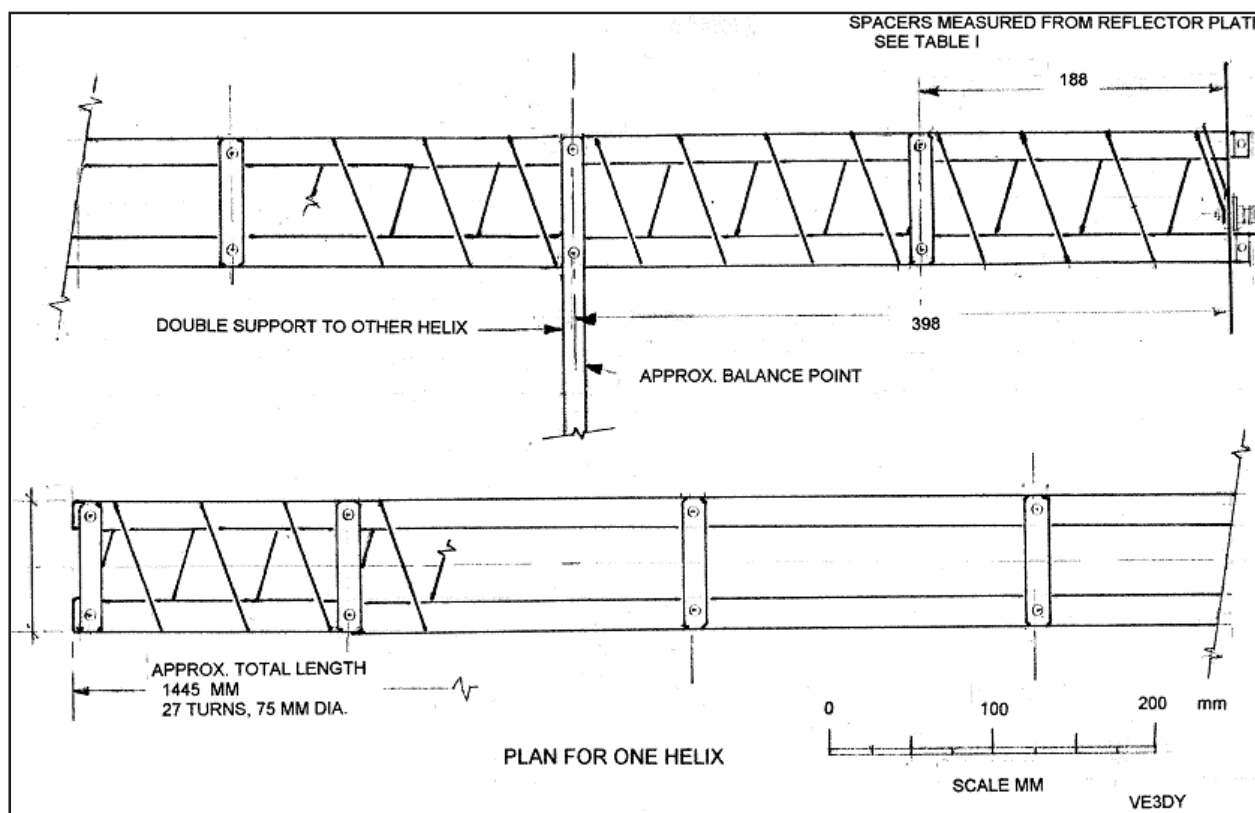


Figure 2 - Antenna Details - Side View

Using the brackets, mount the rails to the reflector plate. Stretch the helix to its approximate length. With the rails adjacent at the outer end, slip the helix coil over the rails and bolt the end of the helix to the screw that is soldered into the end of the N connector. While fitting the helix loops into the notches bolt the cross braces into place starting at the feed end. Omit the third cross brace. Initially the spacing between the helix first quarter turn and the ground plane should be adjusted to about 3 mm by bending the ground plane.

Four-Way 23 cm Power Divider

Theoretical and structural details for quarter-wave power dividers are covered in many of the microwave handbooks. Construction details are shown in Figure 3. Four type N female chassis connectors are fastened with #4 x 1/4 inch self-tapping screws, one on each side of a 1-inch square piece of aluminum tubing cut 207-mm long. A 177-mm length of 1/2" copper water pipe is used for the center conductor. File four equally spaced notches into the ends of the four N connector center pins to accept the end of the copper pipe. The notches should be just deep enough so that the end of the pipe reaches to the center of the N connector pins. A fifth N connector is screwed to one side of the square tubing with the center pin spaced 177 mm from the center pins of the other four. A notch in the copper pipe fits halfway over that center pin. Center the copper pipe and solder the five pins to the pipe. Square plastic plugs can be used to cover the open ends of the power divider.

Joining Cables

To minimize the effects of any impedance mismatch, the lengths of the four cables and connectors that connect each helix antenna to the center conductor of the power divider should be a multiple of an electrical half wavelength. RG-8 or RG-213 coax cable has a velocity factor of 0.66. A cable of four wavelengths at 1269 MHz (23.64 cm) will have a physical length of 624 mm ($23.64 \times 0.66 \times 4$). Allowing for the female chassis connectors at the helix and the power divider, the interconnecting cables should be 600 mm long overall, measured from the open end of each male cable connector.

Helix Array Structure

The helix antennas are arranged in a square 640 mm apart as shown in Figure 4. The four antennas are all oriented in the same way with the position of the N connectors all being in the same relative position so that the output from the antennas will combine in phase. Two sections of tension bars, bolted one on each side of the helix antenna booms, support two helix antennas one above the other. By replacing the third cross brace of each helix antenna with the support bars, the array will be suspended near the balancing point. An H frame using two more sections of tension bars is used to join the double helix antenna sections. A mounting plate made from 3/8" Lexan plastic is used to attach the array to a non-conductive cross boom with muffler clamps. Additional support is provided by bolting sections of tension bars to the rear reflectors. The power divider is fastened to sections of tension bars going between the rear support and the middle H frame.

Both Rails	
1	18.8 cm
2	39.8 cm
3	60.7 cm
4	81.7 cm
5	102.7 cm
6	123.6 cm
7	144.6 cm

Table 1
Cross Brace Spacing from Reflector

SWR Adjustment

The quarter wave matching section on each antenna should be adjusted individually for 1:1 SWR with an SWR meter connected directly to the antenna, using a coaxial barrel adapter. With a plastic tool, adjust the ground plane spacing. As the spacing is pushed from close to the wire to farther away a position should be found where the SWR decreases to 1:1.

If an SWR meter for 23 cm is not available an alternative method is to use a field strength meter and adjust for a maximum reading. The construction of a very simple FS meter is shown in Figure 5. The dimensions of the 2 1/2 to 3 turn helix are non-critical, but keep the leads of the 1 k resistor, the signal diode and the bypass capacitor as short as possible. A 20 kilohms per volt analog multimeter set to the 50 microamp position may be used

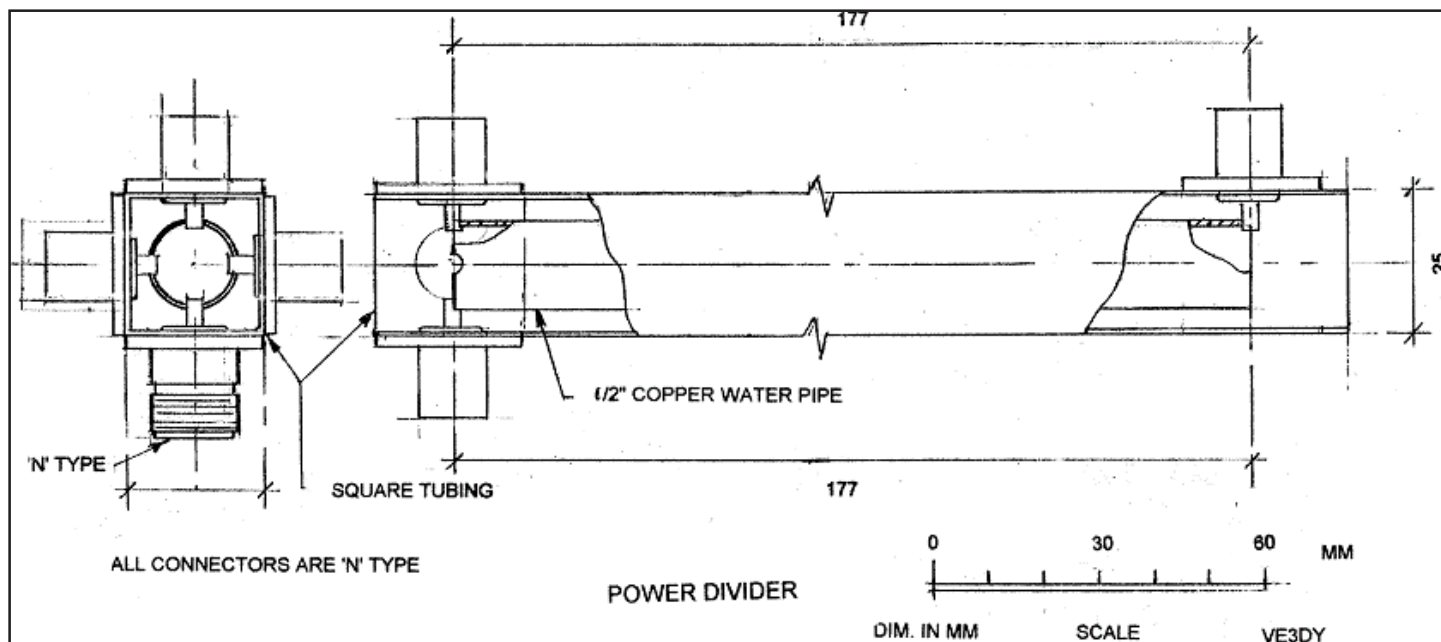


Figure 3
Four-Way Power Divider



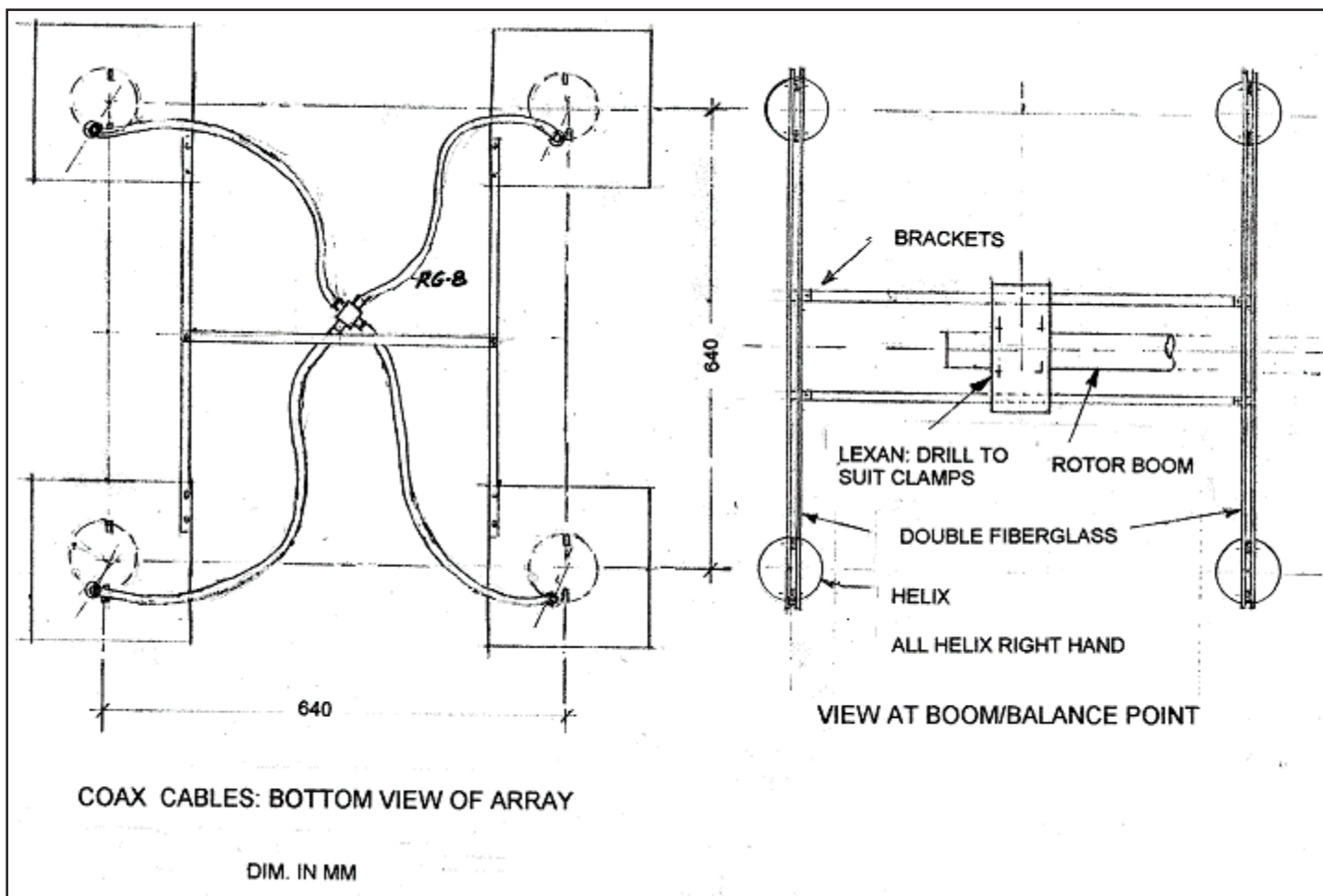


Figure 4
Array Configuration and Wiring

23 cm Helix Antenna Specifications	
Frequency = 1269 MHz	Theoretical Array Gain = 25 dB
Circumference = 1 wavelength	Probable Gain = 23 dB
Number of Turns = 27	Theoretical Beam Width = 11 degrees
Pitch Angle = 12.5 degrees	Antenna Gain = 19 dB
Spacing Between Turns = 52.4 mm	Helix Diameter = 75 mm
Beam Width = 21 degrees	Reflector Side = 200 mm

Sources for Chain Link Fence Fiberglass Tension Bars

The Home Depot
Lowe's
ACE Hardware
True Value

Manufacturer: Master-Halco, Inc.

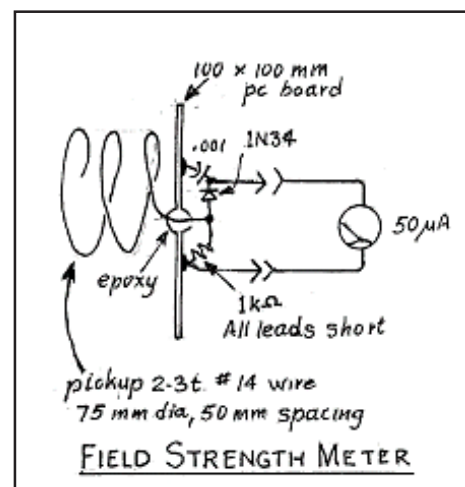


Figure 5
A Useful Field Strength Meter
to Adjust Antenna SWR/Performance

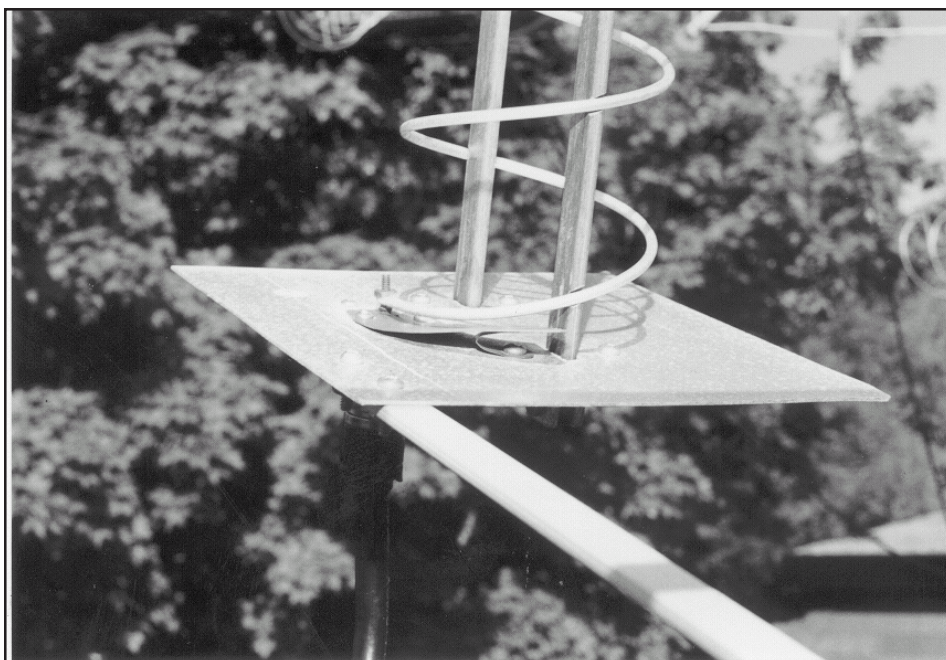


Photo 2
Close-up of Matching Section

for the meter. Position the FS meter helix two or three meters in front of, and facing the 27-turn helix being adjusted. Apply a 1296 MHz signal from the transceiver to the 27-turn helix. Only a small amount of power should give a good meter reading. Adjust the ground plane spacing for maximum field strength meter reading. To facilitate reading the meter while making adjustments the multimeter connecting wires can be extended. Adjust each antenna matching section individually and make no further adjustments.

Feed Line

For this antenna array to provide good L band operation on AO-40 with a drive of 10 watts from the transmitter, the feed line must have a total loss of no more than 2 dB, preferably less. This requires a relatively short, low loss feed line, e.g., 10 meters or less of hard line with 1.5 meters or less of low loss flexible coax at the antenna and in the shack.

Variations on a Theme

Assuming a low loss feed line, 20 watts of power driving an array of two helix antennas would provide equivalent performance. A two-way power divider will be required in place of the four-way divider. A two-way divider requires a center conductor with an OD of 98-mm (use 13/32 in. brass tube) with the length remaining the same.

With a drive of 40 watts or more a single 27-turn helix will give good performance with 2 dB or less feed line loss. If the feed line has a total loss of more than 2 dB, performance can be maintained by increasing

the driving power using an amplifier in the shack or at the antenna.

Working with Fiberglass

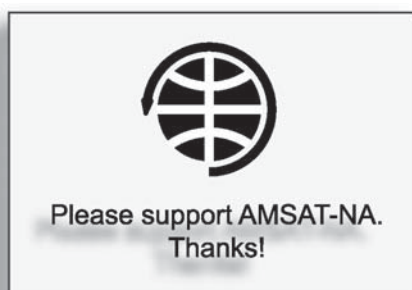
Some people are adversely affected by fiberglass. In any case, precautions should be taken when cutting drilling or filing fiberglass to protect against the dust. Wear glasses, a mask and gloves. Wash areas where the dust comes in contact with the skin.

Acknowledgments

Thanks are due to Gordon Grant, VE3DY, for all of the drafting. 

	Bottom Rail	Top Rail
1	4.4 cm	1.8 cm
2	9.7 cm	7.0 cm
3	14.9 cm	12.3 cm
4	20.1 cm	17.5 cm
5	25.4 cm	22.8 cm
6	30.6 cm	33.2 cm
7	35.9 cm	38.5 cm
8	41.1 cm	43.7 cm
9	46.3 cm	49.0 cm
10	51.6 cm	54.2 cm
11	56.8 cm	59.4 cm
12	62.1 cm	64.7 cm
13	67.3 cm	69.9 cm
14	72.5 cm	75.2 cm
15	77.8 cm	80.4 cm
16	83.0 cm	85.6 cm
17	88.3 cm	90.0 cm
18	93.5 cm	96.1 cm
19	98.7 cm	101.4 cm
20	104.0 cm	107.0 cm
21	109.2 cm	107.0 cm
22	114.5 cm	111.8 cm
23	119.7 cm	117.1 cm
24	124.9 cm	122.3 cm
25	130.2 cm	127.6 cm
26	135.4 cm	132.8 cm
27	140.7 cm	143.3 cm

Table 2
Notch Spacing from Reflector



Another milestone for AMSAT!

March 3, 2004 marked the 35th anniversary of AMSAT's incorporation. The Radio Amateur Satellite Corporation incorporation papers were filed on March 3, 1969 in the District of Columbia. The original incorporators who signed the Articles of Incorporation were George Kinal, Jan King, Perry Klein, C.A. Petry and James Puglise.

Quoting from the original Articles of Incorporation:

The scientific purposes for which said corporation is organized shall be the carrying on of scientific research in the public interest by the means of:

- Providing satellites that can be used for amateur radio communication and to conduct experiments by suitably equipped amateur radio stations throughout the world on a non-discriminatory basis.
- Encouraging development of skills and the advancement of specialized knowledge in the art and practice of amateur radio communications and space science.
- Fostering international goodwill and cooperation through joint experimentation and study, and through the wide participation in these activities on a noncommercial basis by radio amateurs of the world.
- Facilitating communications by amateur satellites in times of emergency.
- Encouraging the more effective and expanded use of the higher frequency amateur bands.
- Disseminating scientific and technical information derived from such communications and experimentation, and encouraging publication of such information in treatises, theses, trade publications, technical journals or other public means.

It's interesting to see how these purposes still apply some 35 years later.

73, Perry, W3PK

Congratulations to all AMSAT members past and present, and particularly to those farsighted individuals who 35 years ago brought AMSAT into existence. With the growth of AMSAT into international organizations based on all habitable continents, AMSAT is more than the sum of its technological parts, promoting peace, education, technology and communication skills. I feel honored to have had the opportunity to have a part in AMSAT's life.

73, Robin Haighton, VE3FRH
President, AMSAT - NA

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Modifying Used Primestar Dishes for Use on S-Band

by Bob Johnson, W7LRD, w7lrd@juno.com

Early on in the AO-40 experience, I realized a dish would be required to receive the S-band downlink from the satellite. Having a severe case of microphobia, I cautiously entered the fray. I eagerly read all the AMSAT-BB give and take and checked out all the dish guru web sites. At about this time the local cable company was having a promotion offering a credit toward several months of a programming package to potential customers if you turned in your dish. I realized there must be a pile of used dishes somewhere.

Searching the Boneyards

After making many calls to the cable company, I finally found someone that had a sense of what I wanted. Permission was granted for me to visit and I was lead to the pile of used antennas. I left with two Primestar dishes (36" X 26") and a couple of 18" DirecTV dishes. I gave one Primestar dish to a friend of mine, Tracy, K7KCS. In return he built and gave me a 5½-turn helix feed for my dish. (see photo)

I started to take note of these obsolete dishes on roofs, in yards and I thought, "there are more piles out there". This appeared to present an opportunity to me. The opportunity was the ability to find, modify and perhaps selling a few of these dishes. Going through a slow down at work has reduced radio funds to zero. I started simply knocking on doors, politely explaining who I was and why I wanted their old dish. This is the tricky part. Many people equate Amateur Radio to CB radio. Standing there in the doorway you have just a few minutes to explain what Amateur Radio is and that we have our own satellites in orbit, for our own use. Some people are amazed at this. Some develop a "100 yard stare" and simply dismiss me. A good sales pitch was developing and I was acquiring a few used dishes.

My local newspaper has a deal that if you are giving something away they will run your ad for three days for free. My ad read, "Free Primestar Dish Removal." I started getting calls, not many, but some. In the process I obtained a 7.5-foot dish and a 12-foot "C" band dish complete right down to the remote control. The 12-foot dish is in the process of being installed, but that's another story. I still rerun the ad on occasion. I have turned down many, many BUD's (big ugly dishes).

Clean-up and Modification

Once I obtain a dish the process is quite simple. A thorough cleaning is done (it's amazing the aim birds have). All the

unnecessary hardware is removed and a feed assembly is built. The 5½-turn helix works well with the Primestar though the original non-supported coil is very fragile. I made a prototype helix with a plastic support for the helix, to give it some structural integrity. Many of the dish experts have stated that the presence of a dielectric in the vicinity of the coil can mess up the pattern. I tried feeds with and without the support with same dish, the same downconverter using the same signal source and tested the signal strength using only the "S" meter. I could see no difference in received signal. I realize that to the purists out there this is a sacrilege. I feel it is an acceptable compromise, since my entire radio station is an acceptable compromise.

The Primestar TV system, was fairly popular subsequent to being absorbed by another satellite TV company. Following this thinking, I started calling around to local dish TV installers hoping to find the mother lode. After many days of inquiring I reached a guy who said, "Yeah, I have a back yard full of them.". This guy had several hundred of the four various sizes that Primestar produced. We worked out a deal and I bought ten of the 36" X 26" size dishes. Over the last year I have been selling these dishes with a feed assembly for \$80.

Currently I use two Primestar dishes. One 36 X 26 is mounted at fifty feet inside my HF cubicle quad. It is fixed at about five degrees above the horizon. This enables me to see over local obstructions. A second Primestar dish (48" X 54") is at fifteen feet and is used for all elevations above ten to fifteen degrees. These antennas work very well for 'S' band, and for the creative hunter can be had for nothing.

This is being written in early February and the future of AO-40 is unknown at this time. I hope AO-40 is recoverable. If not, 'S' band is still in the future of our satellites. 🌐



Modified Primestar dish with helical feed



Close-up view of the helical feed



48 x 54 Primestar dish mounted in the yard



36 x 26 Primestar dish mounted on my tower with my cubical quad



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Ron Marosko, K5LLL, high bidder for the bronze casting created by SK, Floyd Thorn, N5SVP, receives this unique memento of the AO-40 project from Bill Tynan, W3XO, who obtained the piece of art for AMSAT from Thorn's estate. The presentation was made at the February meeting of the Roadrunners Microwave Group held at Zimmerhansel's Bar-B-Que in Smithville, Texas.

AO-40 Sculpture Auction

The AO-40 sculpture auction on e-Bay has produced \$1225 in support of Echo launch. Congratulations and thanks to Ronald Marosko, Sr., K5LLL, of McDade, TX, who was the winning bidder. See the picture at left.

Jim Jarvis, N2EA
AMSAT Director of Marketing



AMSAT-NA Board of Directors Nominations

It is time to submit nominations for the AMSAT-NA Board of Directors. AMSAT Member Societies or five current individual members may make nominations of fellow members to serve a two-year term. Three seats on the seven-member board must be filled this year. Those whose terms are expiring are: Tom Clark, W3IWI, Lou McFadin, W5DID and Bruce Paige, KK5DO. Nominations should be sent to: AMSAT, 850 Sligo Ave, #600, Silver Spring MD 20910 and must arrive no later than JUNE 15th.

Southeastern VHF Society 8th Annual Conference Atlanta, GA, April 23 & 24, 2004

We have been working hard on putting together a great technical and family program for our attendees. The technical program is packed full of great presentations and a listing of them will be available on the SVHS Web site. Here are just a few of the presentations: Introducing New Hybrid Modules, Steve Kostro, N2CEI, 6M EME With a Rope Yagi, Tommy Henderson, WD5AGO, & Al Ward, W5LUA, and The Most Fun You Can Have With a Rock, Dennis Motschenbacher, K7BV.

Our Family Program Chairwoman, Shirley Adams, has a good program for the wives in the works. One activity is a big arts and crafts show that will be in town during the conference. Another trip will be to a large outlet mall in Dahlgonega and lunch at the Smith House. Shirley is looking to get some numbers on how many wives will be attending so she can arrange for enough transportation. If your wife is attending please contact Shirley via Ws4fher@aol.com.

Here are some highlight activities from the conference:

- Southeastern VHF Society/Mini-Circuits Annual Award for Design Achievement. This is a circuit design competition co-sponsored with Mini-Circuits that has a first prize of either \$1000 cash or a \$2500 gift certificate for Mini-Circuits products. Second thru sixth place winners would receive gift certificates worth \$200. The design competition is for SVHFS members (registration for the conference includes your membership). Detailed rules are on our webpage at www.svhfs.org. The panel chairman for the design award is Charles Osborne, K4CSO, and he can be reached at cosborne@pari.edu.
- Worked All of 'EM' Award. This operating award is for working all the Grid Squares in the EM field on VHF frequencies. This is a new award sponsored by the SVHFS and is open for all to participate in.

- 'Kick-Off Lunch' on Friday with our guest speaker Gene Zimmerman, W3ZZ, the editor of the 'World Above 50 MHz' in QST.

Our Web site has been updated this past week. Check out our 'Latest News' page for latest info about what is going on in the SVHFS. We have registrations forms, conference flyers and more available on our downloads page. You can find us on the web at www.svhfs.org.

CU in Atlanta!

73,

Greg, KB4NVD

SVHFS Publicity Chairman

SVHFS Conference April 23&24, 2004
Atlanta, GA

Rover@wireco.net

www.svhfs.org 

SKN on OSCAR

Many thanks to all who participated in AMSAT-NA's 32nd annual Straight Key Night on OSCAR, 1 January 2004. With only AO-7 and FO-29 available for use this year, the activity level was down from the record high participation of 2003, but as always a good time was had by all who took part.

Our Best Fist winners for 2004, each nominated by someone he worked, are:

Richard Limebear, G3RWL

Cliff Buttschardt, K7RR

Keith O'Brien, N4ZQ

Al Ozias, N7EQF

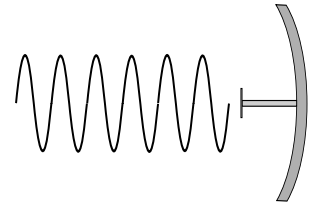
Al Tribble, W3STW

Congratulations to all.

See you all next year!

73,

Ray Soifer, W2RS
for AMSAT-NA



A Dialogue - continued from page 21

[Anon] Other stuff AMSAT could change to move into the latter part of the 20th century: How about ANS moving to sending out MIME e-mail digests rather than the hokey format we continue to use today? Does anyone really gateway these things into packet radio BBS systems any longer?

[Robin] Two answers here - One is that when I proposed this change, I got many responses from around the world, from member AMSATs, who, much to my surprise, do send the ANS bulletin to the far reaches of the world by packet. Just because we in North America don't use much packet, does not mean our friends around the world do not. Secondly, the use of plain text also means we manage to keep many spam items out of the ANS, i.e., they cannot be inserted. I have looked at two editions of the ANS, one in MIME with color and pictures for North America and one still following the old system (which does work). Currently it is still under discussion for the reasons above.

[Anon] Do they even exist any more? Probably 99% of the readers getting the ANS news receive it with email. Change is hard. The temptation to reinvent the wheel and cling desperately to it is very strong.

[Robin] No, that is not the case, if we can use a more effective system to pass the message then we will. But if it would cause problems then we do not have full time staff to solve the problems, all of AMSAT with one exception, are volunteers, we are very proud of that, because volunteers are dedicated to achieving the right results, otherwise they would not volunteer.

[Anon] Ed, I didn't intend to vent my complete set of issues about AMSAT to you. You were very kind to reply to my message on the AMSAT-BB Internet email list. It seems my reply turned into something longer than I expected, and now I find myself standing on a very high soapbox. My congratulations and thanks to you, Ed, for taking on the role of editor of the Journal. I'm sure you get more complaining and moaning than praise, but no good deed goes unpunished :-)

[Robin] Ed is a volunteer.

[Anon] Regards, er, "73 OM" in the ancient language of spark.

Anon, Ham Radio Operator

[Robin] Anon,

You raised some excellent points, and I acknowledge that some of my answers are quite direct and to the point. However also as a Volunteer, I felt that I should give you the "Straight Facts" at least as I see them. You took a long time to write your e-mail to Ed, and similarly I have taken a fair while to reply. I hope you will seriously reconsider your membership in AMSAT, and possibly become another volunteer.

By copy of this E-mail I am asking Ed to consider printing this correspondence in The AMSAT Journal if he considers it worthwhile (he is the editor and I don't mess with the editor's decisions). That is subject to your agreement. I do this as you raise good points and I would like the membership to read the responses - yes all of them.

73,

Robin Haighton, VE3FRH

President AMSAT and a volunteer 



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